SUMMARY REPORT

OF THE

GEOLOGICAL SURVEY DEPARTMENT

FOR THE YEAR

1900

PRINTED BY ORDER OF PARLIAMENT

OTTAWA
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1901

[No. 26—1901.]

To His Excellency the Right Honourable the Earl of Minto, Governor General of Canada, &c., &c., &c.

MAY IT PLEASE YOUR EXCELLENCY :

The undersigned has the honour to lay before Your Excellency, in compliance with 53 Vic., Chap. 2, Section 6, the Summary Report of the Proceedings of the Geological Survey Department for the year ending December 31, 1900.

Respectfully submitted,

CLIFFORD SIFTON,

Minister of the Interior.

JANUARY, 1901.

SUMMARY REPORT

ON THE

OPERATIONS OF THE GEOLOGICAL SURVEY

FOR THE YEAR 1900.

OTTAWA, January 15, 1901.

The Honourable CLIFFORD SIFTON, M.P.,
Minister of the Interior.

SIR,—I have the honour to submit herewith the Annual Summary Report of the Geological Survey Department, which, in conformity with the Act, covers the proceedings and work of the Survey during the past calendar year. In this report, especial prominence is given to the results of field-work accomplished during the past summer, thus affording an early publication of a preliminary kind for any new facts obtained, whether of economic or of scientific importance. It must at the same time be remembered that this report relates merely to work done by the Geological Survey Department or in connection with which this Survey has taken some part. It can not therefore be regarded as in any sense a general review of the progress made in the subjects to which it relates in Canada as a whole.

Nature of this report.

Although the printing of volume XI. (new series) of the annual reports of the Geological Survey (English edition) was stated to be in progress in my Summary Report of last year, the completion of the volume has unfortunately been delayed owing to circumstances not under the control of this Department. This volume is now, however, nearly ready for issue. Its constituent parts, with two exceptions, have already been separately made available to the public. They are as follows:

Printing of Volume XI.

Separate reports contained in this volume.

Summary report of the Geological Survey Department for 1898, by the Director

Report on the Geology and Natural Resources of the country traversed by the Yellow Head Pass route, by J. McEvoy.

Report on the Geology of the west shore and islands of Lake Winnipeg, by D. B. Dowling.

Report on the east shore of Lake Winnipeg and adjacent parts of Manitoba and Keewatin, from notes and surveys, by J. B. Tyrrell.

Report on the Geology of the Three Rivers map sheet or north-western sheet of the 'Eastern Townships' map, Quebec, by R. W. Ells.

Report on an exploration of part of the south shore of Hudson Strait and of Ungava Bay, by A. P. Low.

Report of an exploration on the northern side of Hudson Strait, by R. Bell.

Report of the section of Chemistry and Mineralogy, by G. C. Hoffmann.

Report of the section of Mineral Statistics and Mines, by E. D. Ingall.

Maps. The volume will be accompanied by four coloured geological maps pertaining to several of the above mentioned reports.

The French edition of volume X. (new series) has I regret to say not yet been received from the printers. The translation of the parts composing volume XI. is well advanced.

Special publications issued during 1900. A number of special publications, distinct from those included in the annual volumes, have been issued during the past year. These are as follows, in the order of their publication.

Descriptive note on the Sidney Coal Field, Cape Breton, N.S., to accompany a revised edition of the Geological map of the Coal Field, by H. Fletcher.

Summary of Mineral production of Canada in 1899. Issued Feb. 27, 1900.

Preliminary Report on the Klondike Gold Fields, Yukon District, by R. G. McConnell.

Catalogue of Canadian Birds. Part I., by J. Macoun.

List of publications of the Geological Survey of Canada (revised to date).

Descriptive Catalogue of a collection of the Economic Minerals of Canada. Paris Exhibition, 1900.

Catalogue descriptif des minéraux du Canada. Exposition Universelle de 1900. Paris.

General index of the reports of the Geological Survey from 1863 to 1884, by D. B. Dowling.

Mesozoic Fossils, vol. I., part IV.—On some additional or imperfectly understood fossils from the Cretaceous rocks of the Queen Charlotte Islands, with a revised list of the species from these rocks, by J. F. Whiteaves.

Report on Klondike.

The preliminary report on the Klondike Gold Fields, above alluded to, was subsequently embodied in the Summary Report for 1899, but the separate copies were widely distributed in advance.

General Index.

The general index of reports, as now issued, forms a volume of 475 pages. It is intended to be followed by a similar index of the first ten volumes of the new series, but as this is a work of much labour its completion will require some time. The catalogues of the Canadian minerals exhibit at Paris, in English or French, were prepared in this office and it is intended to distribute copies of them to our exchanges as a matter of record. They comprise 217 and 234 pages respectively, and are further alluded to in the sequel in connection with the exhibition work.

Maps issued.

During the year 1900, twelve new maps have been completed and printed and eighteen are at the present time either in the engraver's hands or in press. These are enumerated in the report of the chief draughtsman on a later page.

Some of the publications above enumerated have not yet been distributed to our exchanges or to those otherwise entitled to them, owing to the rearrangement of our lists of addresses, which has been in progress, but is now nearly completed.

Altitudes in Canada.

Previous to his transfer from this Department to the Interior Department, Mr. James White had undertaken the preparation of a list of *Altitudes in the Dominion of Canada*. This, which has proved to be a most laborious work, has now been completed by Mr. White, and is among the publications actually in press at the present time.

New museum building necessary.

It is still unfortunately necessary to draw attention to the want of a safe or sufficiently commodious building for the museum and offices of the Geological Survey. The danger of the total destruction of the invaluable collections and records by fire continues, while the inadequacy of space for the display or even for the storage of valuable and interesting specimens becomes more serious daily. This matter has so often been urged and so fully explained in previous reports that it is unnecessary here to enter into detail. The need of a new building is, however, a very pressing one.

Information supplied by correspondence.

The number of inquiries received and replied to continues to increase each year. Most of these relate to minerals of commercial value, some to points of a purely scientific character, some to geographical questions, and many can only be classified as miscellaneous. The familiarity of members of the staff with all parts of Canada, often renders it possible to afford information of a local kind to inquirers that may be of importance to them. In addition, large numbers of specimens of ores, rocks and natural objects of all kinds are received and examined for the senders, and requests are frequently made for the

addresses of the producers or purchasers of various substances. Much time is spent by several members of the staff in dealing with such matters by correspondence, but the results are of undoubted value to the public.

Minerals inquired for.

The following minerals are cited as having been specially inquired for during the year by intending purchasers or those wishing to employ the substances practically. Repeated inquiries have been received in regard to some of them :— Albertite, Asphaltum, Asbestus, Bituminous shale, Beryl, Bauxite, Chromic iron, Corundum, Chalk, Elaterite, Fire-clay, Felspar, Hæmatite, Iron sand, Iron-pyrites, Kaolin, Limestone, Magnesite, Magnetite, Manganese, Molybdenite, Mica, Marble, Monazite, Petroleum, Phosphate (apatite), Slate, Tin, Zinc, Zircon.

Parties in the field.

The following statement shows the number and distribution of the parties at work in the field during the past season :—

Yukon District	1
British Columbia	3
Mackenzie District	1
Ontario	3
Ontario and Quebec	1
Quebec	1
New Brunswick	2
Nova Scotia	1
	13

The above represent parties engaged continuously during the greater part of the summer in geological work. The detachment of Messrs. Low and Faribault to special work in connection with the exhibition in Paris, the appointment of Mr. A. E. Barlow, as lithologist, the assignment of office work to Mr. D. B. Dowling, and the inability of Dr. F. D. Adams to continue work for the survey in 1900, reduced the ordinary number of field parties; while the interruption in experimental boring operations in Alberta also reduced the number by one. It was endeavoured to compensate these temporary losses in the field force by arranging for special work by gentlemen not on the survey staff, but who had sufficient field experience, and Messrs. J. M. Bell, W. A. Parks and G. A. Young were thus employed, as detailed on later pages.

Field work of other kinds.

Geological work was also carried out for shorter periods during the summer by Messrs. Ami, Barlow, Ingall, Denis and Le Roy. At the suggestion of, and by special arrangement with the Hon. G. W. Ross, Premier of Ontario, Prof. J. Macoun undertook a Natural History Survey of the Algonquin Park area of Ontario. His preliminary

statement is printed herewith, and a detailed report will be prepared by him on the area in question.

Report of Prof. Osann.

Professor A. Osann, of Mülhausen, Germany, has now practically completed his work on the apatite and graphite-bearing rocks of that part of Quebec to the north of the Ottawa river, and a report embodying his results is expected shortly. The Survey is greatly indebted to Professor Osann for his labours in this connection.

Work by Dr. G. F. Matthew.

Dr. G. F. Matthew, has been able to continue during some weeks in the past summer his examination of the Cambrian rocks of Cape Breton island, with important results. It is hoped that after further work, which appears to be still necessary, he may be able to furnish a complete report upon the older rocks of this interesting region, and on their contained fossils.

Prof. J. A. Dresser.

Professor J. A. Dresser, of St. Francis College, Richmond, Quebec, is now nearly ready to complete his monograph on the structure and petrography of Shefford mountain; being the results of an investigation which he has carried on with but slight assistance from the Geological Survey. A brief report on this work is given on a later page.

Work on iron ores.

The work accomplished by Messrs. Ingall and Denis, bearing on the iron ore deposits of Eastern Ontario, is further referred to in the report of the Section of Mineral Statistics and Mines, in the sequel. On a later page a short report by Mr. O. E. LeRoy, is also given, noting the progress made in the mapping of formations near Montreal, in connection with an investigation of artesian wells there, which have been made the subject of study by Dr. F. D. Adams, and upon which that gentleman offers a report for publication by the Geological Survey.

Geology of Montreal.

Collection of fossil vertebrates.

The late Prof. D. E. Cope had in his keeping, at the time of his death, some considerable collections of Cretaceous and Tertiary vertebrate remains made by officers of the Survey in the North-west Territories. He had examined and described some of these in *Contributions to Canadian Palæontology, Vol. III., Part I.* Since that time efforts had been made to obtain additional material, particularly from the Cretaceous beds of the Belly River formation, Mr. L. M. Lambe having spent parts of two seasons in the field with that object. With a view to getting this material dealt with under the auspices of a recognized authority, I communicated early in the year with Professor H. F. Osborne, Curator of Vertebrate Palæontology of the American Museum of Natural History, New York, who very promptly and kindly undertook to supervise the work on vertebrate fossils in the possession of the Survey. Prof. Osborne visited Ottawa in April, and since that time Mr. Lambe has been occupied, under his guidance, in working up and drawing these fossils for publication. The survey is deeply indebted to Professor Osborne for his wholly gratuitous assistance in this

Collaboration by Prof. H. F. Osborne.

matter. When the investigation is completed, it is intended to publish the Cretaceous material as a second part of the volume above referred to.

Acknowledgments for assistance.

Besides the gentlemen above named, the Survey has as usual been indebted during the past year to a number of scientific men for assistance given by them in connection with its work. Among these the following may be especially mentioned :—Dr. S. H. Scudder, Cambridge, Mass ; Dr. Wheelton Hind, Stoke-on-Trent ; Professor J. B. Porter, Montreal ; Mr. R. Kidston, Stirling, Scotland ; Mr. David White, U. S. National Museum, Washington ; Dr. Henry Woodward and Mr. A. Smith Woodward, of the British Museum.

Testing of economic minerals

During the year a number of specimens of mineral products have been obtained and sent out as samples or for purposes of examination by experts. In this connection, the following may be mentioned :—

Mica.

Mica.—The growing importance of the mica industry, particularly in the Ottawa district of Quebec and in parts of Eastern Ontario, has given rise to various questions in regard to the product of the mines and workings. This is an 'amber mica' or phlogopite, employed in the construction of electrical machinery. The market has been so far chiefly in the United States or in Canada, where higher prices have been realized than could be obtained in competition with Indian mica in Great Britain. As the Indian mica has throughout been equally available to customers in the United States, there appeared to be reason to assume that the preference for the Canadian 'amber mica' really indicated a superiority in quality for electrical purposes, dependent on the high degree of insulation afforded by this mica, with its flexibility and softness, the latter quality enabling sheets of requisite thickness to wear down equally with the adjacent copper.

Specimens reported on by Prof. W. R. Duncan.

Advantage was therefore taken of the kind offer of Professor Wyndham R. Duncan, F. R.S., Director of the Scientific and Technical Department of the Imperial Institute, London, to submit some specimens of the Canadian 'amber mica' to the special examination of experts. From Prof. Duncan's report upon these tests, lately received, the following extracts may be given. They appear fully to bear out the opinion formed as to the exceptionally high value of this mica for electrical purposes.

'The four samples consisted of very fine specimens of Canadian "knife-trimmed" amber mica, labelled as follows :—

1. Wallingford Mine.
2. Lake Gerard Mine.
3. Vavasour Mine.
4. Blackburn Mine.

'They are stated to represent a fair average commercial quality and size.

'General physical and chemical examination showed that the samples were uniform in character, pliable and softer than much of the mica which appears in the English market.

'In order to ascertain its commercial value, and especially its fitness for electrical purposes, the samples were submitted to one of the largest electrical manufacturers in London, and also to one of the largest mica brokers in the city.

'The electrical manufacturers report that the mica is suitable for a variety of electrical purposes, but they refrain from quoting a price for it and recommend that this could be done better through mica merchants. Electrical manufacturers.

'The mica merchants have taken considerable pains in examining the samples and have made a very full report. They state that the approximate values in the London market are as follows :—' Mica merchants.

[The values range from 1s. to 5s. 6d. per pound for the actual samples sent, but as the values depended more on the size of the plates actually sent (which were far from uniform) than on the intrinsic peculiarities of the specimens, it might be misleading to publish these figures in conjuction with the names of the several mines.] Prices.

'It is evident, however, that greater importance is attached to the size of the plates in the London market than in that of the United States.

'The brokers add that the Wallingford sample, being of especially fine quality, would be eagerly sought after in the British market. The product of the Vavasour Mine would also command a large sale here. The Blackburn sample, to which a large price is attached chiefly on account of the size of the plates, shows rather serious cracks and is not quite flat, otherwise it would have been of even greater value. It is also pointed out that the Lake Gerard mica ought to command greater success in the British market than has been hitherto the case. Its indifferent success is attributed by the brokers chiefly to an attempt to direct business through a London office, instead of proceeding through the usual channels. Opinions on different subjects.

'On the general question of the uses and comparative value of the Canadian amber mica, the brokers remark that this variety of mica is of no other value than for electrical purposes, its special value being principally due to its softness and easy lamination. They are of opinion that Canadian amber mica is of greater value for electrical work than most of the Indian mica that comes to this country. They remark, however, that there are two or three varieties of Indian mica, General character of Canadian amber mica.

such as White Bengal, Cochin, from the west coast of Madras and Ceylon amber mica which compare very favourably with Canadian product, whilst the selling prices of these Indian varieties are often from one-third to one-half those asked for the Canadian mica. They confirm the opinions expressed in Dr. Dawson's letters of February 16 and April 4 of this year, that Canadian miners obtain a better price in the United States than in the London market, chiefly from the circumstance that American electricians prefer the Canadian product which is close at hand and can be depended upon for uniformity of quality and regularity of supply.

Markets.

'Although circumstances point to the United States as being the natural outlet of Canadian mica, nevertheless it would be worth while to take steps to make it better known in the British market, since there are several factors operating against the Indian product, especially in the matters of tariff and regularity of supply.

'If the proprietors of the mines represented by the samples now under consideration are of opinion that the values quoted are sufficiently encouraging to make it worth while to send trial shipments to this country, I shall be glad to put them in communication with the brokers who have expressed their willingness to give then any assistance in their power.'

Molybdenite.

Molybdenite.—A number of inquiries received during the past few years have drawn attention to known Canadian deposits of this mineral, but none of the owners of such deposits appear to have attempted to work them. Molybdenite often occurs in rather small proportions in the containing rock or vein-stone, and it seemed possible that such deposits might be utilized on a comparatively large scale, if the mineral could be obtained in pure form by any economic process of concentration. Professor J. B. Porter of McGill University, having offered to subject ores and minerals sent by the Geological Survey to practical tests in the finely equipped mining laboratory of the university, Mr. C. W. Willimott was instructed to obtain a couple of bulk samples of molybdenite ores from well known and accessible localities, for this purpose. These were secured from lot 69 Range IV. Egan township, Wright county, Quebec and from lot 22, Range II. Ross township, Renfrew County, Ontario, respectively. They were treated by Messrs. S. F. Kirkpatriek and W. A. Moore under Professor Porter's superintendence.

Tests made by Prof. J. B. Porter.

Ore from Egan township.

The first, or Egan township sample, weighing 289 pounds, and containing in all 15·92 per cent of molybdenite, was cobbed and hand-picked in the Survey, yielding 39 pounds of clean mineral in crystalline flakes. The remaining 250 pounds of the cobbed ore was then sent to Professor Porter, who ascertained that it still contained 2·8 per cent

of molybdenite. By a dry process of rolling and screening, followed by jigging, nearly all the molybdenite was extracted from this ore, in a series of concentrates ranging from 70 per cent to 15 per cent in molybdenite. It is not necessary to refer to the details of treatment here, but the results appear to show that in the case of molybdenite ore of this class, in which the crystalline masses are of considerable size, it would not be economically possible to employ any crushing and concentrating process. The problem resolves itself into one of cobbing and hand-picking at remunerative rates. The associated minerals in this case were, pyroxene, iron-pyrites and mica.

Ore from Ross township.

The second, or Ross township sample, weighed 250 pounds. The gangue was chiefly quartz, and, although the molybdenite made a considerable showing, it was found by Professor Porter to amount to only about one per cent. This specimen was not cobbed or hand-picked. By concentration it was determined that about 52 per cent of the molybdenite could be saved in the form of a concentrate containing 33·50 per cent of the mineral. The grade of this concentrate appears, however, to be too low for present commercial requirements.

Auriferous sands from Atlin.

Auriferous Black Sands.—Some samples of auriferous black sands from sluice-boxes in the Atlin district, British Columbia, were collected by Mr. J. C. Gwillim. From these, after the coarser gold is secured, the very fine gold is separated with difficulty, amalgamation being in some cases employed. The samples were, through Professor J. B. Porter's kindness and under his superintendence, subjected to treatment with the Wetherill Magnetic Separator by Dr. A. E. Barlow and Mr. Andrews. The results are interesting, and satisfactory in showing that by this method a very large proportion of the heavy minerals may readily be removed, leaving a very rich auriferous product. The results seem to suggest the possible utility of the employment of this new machine in treating black sand concentrates obtained in gold dredging operations. Professor Porter's report is as follows:—

Treatment.

'The several samples received were all treated exactly alike. Each was passed through the Wetherill Magnetic Separator three times. The first time with a current of ·15 ampere or 1,207 ampere turns; the second with 1·5 amperes or 12,075 ampere turns and the third with 3·8 amperes or 30,590 ampere turns in the magnets.

'The distance between the main and cross belts was the same in each case, $\frac{2}{10}$ inch for A magnet and $\frac{11}{100}$ for B magnet.

'In the first pass only one product was made, the B magnet removing so little that it was not weighed and was permitted to go in with B product of the second pass. In the other cases two products were made for each pass, and the non-magnetic materials from the last pass constituted the "tails" which in these tests were the valuable portions.

'As the samples were all very small, we did not make any attempt to keep separate the various magnetic portions. Each was examined by the eye and its character noted, and then all of the magnetic portions of each sample were mixed, ground and assayed.

Pine Creek.

'*Pine Creek*, Black sand.—Atlin.

Total weight of sample.....9·40 grammes.
Magnetic portion.....5·25 "
Non-magnetic.....4·15 "

'*Assays.*—Non-magnetic, 916 oz. gold per ton. Magnetic, not assayed.'

Stephendyke.

'*Stephendyke*, Black sand.—Atlin.
Total weight of sample, 22·90 grammes.
Pass I. A., 1·35 grammes, chiefly magnetite.
" B., A few grains mixed with II. B.
" II. A., 5·30 grammes, chiefly ilmenite.
" B., 3·40 " ilmenite and garnet.
" III. A., 2·20 " yellow garnet and some ilmenite.
" B., 0·10 " serpentine, epidote, &c.
Non-magnetic, 10·55 " = 46·3 p.c.

'*Assays.*—Non-magnetic, 5,985 oz. gold per ton. Magnetic, 0·4 oz. gold per ton.

'*Remarks.*—The non-magnetic portion carries about 37·5 oz. per ton of platinum or metals of the platinum group, but this cannot be taken as an accurate quantitative result, as the platinum assay was somewhat unsatisfactory.'

Willow Creek.

'*Willow Creek*, Black sand.—Atlin.
Total weight of sample, 128·95 grammes.
Pass I. A., 49·65 grammes. Nearly pure magnetite.
" B., A few grains mixed with II. B.
" II. A., 14·10 grammes serpentinous grains and grains of black mineral (ilmenite and chromite).
" B., 11·75 " serpentine and dark grains.
" III. A., 35·65 " serpentinous grains, &c.
" B., 3·70 " " " "
Non-magnetic, 14·10 " =10·95 p.c. of total.

'*Assays.*—Non-magnetic, 0·5 oz. gold per ton. Magnetic, trace of gold.

'*Remarks.*—The magnetic portion contains a small amount of platinum. This sample was marked "after amalgamation."'

'*Spruce Creek*, Black sand.—Atlin. Spruce creek.

Total weight of sample, 359·50 grammes.

Pass I. A., 311·30 grammes, almost pure magnetite.
" B., A few grains mixed with II. B.
" II. A., 11·00 grammes magnetite and hæmatite.
" B., 14·15 " specular hæmatite and a little magnetite.
" III. A., 13·55 " a mixture of hæmatite and serpentine grains.
" B., 1·10 " serpentinous grains.

Non-magnetic, 8·40 " = 2·3 per cent.

'*Assays.*—Non-magnetic, 52 oz. gold per ton. Magnetic, 0·20 oz. gold per ton.'

'*Boulder Creek*, Black sand.—Atlin. Boulder creek.

Total weight of sample, 90·25 grammes.

Pass I. A., 16·00 grammes magnetite.
" B., A few grains.
" II. A., 9·15 grammes, a little magnetite.
" B., 47·05 " chiefly ilmenite.
" III. A., 5·50 " ilmenite with some brown garnet.
" B., 0·20 " garnet, &c.

Non magnetic, 12·35 " = 13·7 per cent.

'*Assays.*—Non-magnetic, 231·0 oz. gold per ton. Magnetic, a trace of gold.'

'*McKee Creek*, Black sand.—Atlin. McKee creek.

Total weight of sample, 57·4 grammes.

Pass I. A., 18·35 grammes, nearly pure magnetite.
" B, A few grains.
" II. A., 8·90 grammes, chiefly magnetite.
" B., 10·35 " dark minerals containing some magnetite.
" III. A., 10·85 " chiefly serpentinous.
" B., 0·40 " " "

Non-magnetic, 8·55 " = 14·9 per cent.

'*Assays.*—Non-magnetic, 748·5 oz. gold per ton. Magnetic, 1·4 oz. gold per ton.'

Discovery of salt near St Grégoire

In the summary report of this survey for 1887 (p. 33 A), the record of a well bored to a depth of 1,115 feet, near St. Grégoire, Beauce county, Quebec, is quoted from Mr. J. Obalski, Inspector of Mines for the province of Quebec. This well was sunk in search of natural gas, and since that time further sinkings have been made in the same region, but so far without very important results. In March last, however, Mr. Obalski kindly drew my attention to a well bored by Mr. E. Bergeron, on the Concession Pointu, in Bécancour, about two miles east of St. Grégoire village, which was of interest in yielding a rather strong brine. This locality is situated near the western border of an area geologically mapped as of Medina age, characterized at the surface by reddish rocks. The section, according to Mr. Obalski, is approximately as follows:—

Section in well.

	Feet.
Clay (Pleistocene)	35
Gray calcareous sandstone	25
Red shale	545
Bluish shale	5
Reddish 'salt rocks'	50
Yellowish-gray calcareous shales	25
	685

At 195 feet and 240 feet, small quantities of gas were observed. The so called 'salt rock' was supposed to consist in large part of rock-salt and said to dissolve. It appears to have been associated, however, with some limestone.

Salt in the Medina formation.

The log of the boring is evidently imperfect, but, taken in conjunction with some specimens received, it appears that the Medina extends to the depth reached, and that the brine obtained comes from that formation. The thickness of the Medina in the previous boring was supposed to be 565 feet. So far as I am aware this is the first occurrence of salt in the Medina of Canada, although in the state of New York numerous brine springs have been noted in that formation. These are enumerated in a report by Mr. D. D. Luther,* but none of them appear to have possessed any permanent importance for the manufacture of salt, and some are recorded as yie'ding only impure brines. The brine obtained from the present boring, examined in the laboratory of the Survey, proved to contain 3,546 grains (or a little more than eight ounces) of common salt to the imperial gallon, but this was accompanied by considerable quantities of chlorides of calcium and magnesium, besides other impurities in lesser amounts. There is therefore little reason to believe that the salt deposit of this place is likely to be of commercial value.

Brine impure.

* The brine springs and salt wells of the state of New York and the geology of the salt district, 1898, p. 177.

Surveys of Crows Nest coal field

The Act of Parliament authorizing a subsidy to a railway through the Crows Nest pass, having assigned the duty of selecting a certain area of the coal lands of the Crows Nest pass coal basin for the Government to the Director of the Geological Survey, it appeared to be necessary to obtain at an early date all the information requisite to this purpose—particularly in view of the fact that the Crows Nest Pass Coal Company was already actively at work in some parts of the field. Mr. J. McEvoy was, therefore, intrusted with this work. The co-operation of Mr. A. O. Wheeler of the Topographical Surveys Branch, for the necessary survey of the district, was also secured and the methods of work arranged with the Surveyor General.

Inspection by the Director.

In the latter part of August I personally visited the district to ascertain the progress made and the general nature of the results arrived at. As long ago as 1883 I had outlined the area of the Cretaceous coal-bearing rocks of this part of the Rocky mountains, and in 1891, after some exploratory work had been done upon the outcrops of seams, these were visited by Dr. Selwyn, late Director of the Survey

Estimated quantity of coal.

Mr. McEvoy's more detailed work has necessarily to some extent modified the outlines as originally drawn, and has already added much to the precision of our knowledge both in this regard and in respect to the thickness and succession of the seams. His preliminary report is given on later pages, and it will be found to more than justify the earlier statements as to the exceptionally great value of this remarkable coal field, which he estimates to contain over 22,000,000,000 tons of possibly workable coal.

Special conditions met with.

The great value of this coal depends largely upon its excellent coking character and low percentage in ash or other deleterious substances, combined with its position in regard to growing centres of metalliferous mining. It must be added, however, that great skill and care will evidently be needed in properly developing and fully utilizing the field, which in some respects present peculiar conditions. The highly bituminous character of the coal, already gives evidence that very effective ventilating apparatus will require to be installed as the workings extend, in order to avoid dangerous accumulation of gas. The great thickness of some of the seams, with the often tender character of the coal composing them, will present difficulties in the way of cheap and complete extraction; while the fact that levels run in the seams from the bottom of the intersecting valleys are at a depth of 3,000 feet or more below the general level of the surface of the intervening plateau-like areas, may probably render it necessary to contend with exceptional pressure upon the workings as these progress.

Present output.

The output of the Crow Nest pass coal mines is at present over 1,000 tons per diem. Coking ovens to the number of 360 are in operation and large additions are in contemplation.

Discoveries of coal in British Columbia.

In connection with the subject of coal in British Columbia, it may be mentioned here that recent explorations, taken in conjunction with information previously obtained, lead to the belief that large and important coal-fields will be available, when required, in the northern part of that province. The explorations particularly referred to are those which have been carried out for the Department of Railways and Canals under Messrs. J. S. O'Dwyer and A. H. Dupont. Notes and specimens brought back by these gentlemen and handed over to the Geological Survey, show that the coal-bearing Cretaceous rocks occupy a much larger area than had been supposed between the 55th and 57th parallels of latitude, while anthracitic coals have actually been found in the region about the head-waters of the Skeena and Stikine rivers. This northern region may eventually add materially to the already great wealth of British Columbia in coal.

Specimens of bituminous and coking coal of good quality, indicating a new and perhaps important locality for this fuel in British Columbia, have also lately been received from the south side of the Tulameen river, west of Granite creek. This is a fuel of Tertiary age that has been subjected to local condition of alteration, and resembles in this respect and in its character that of the Nicola valley, which has previously been described in the reports of this Survey.

Coals in Yukon district.

The specimens of mineral fuel so far obtained from the Klondike region and from the vicinity of *Forty Mile creek* on the Yukon, have proved to be lignite-coals, possessing only a medium economic value; but, quite recently, samples have been received of an anthracite coal from a locality west of Lake Marsh and near the new line of railway. This proves on assay to contain a very large percentage of ash, but it affords reason to hope that better fuels may be found by search in the same vicinity. It is further referred to in Mr. McConnell's report, in the sequel.

Canadian Mineral Exhibit at Paris.

Preparations for Paris Exhibition

The preparations made, under the auspices of the Geological Survey, for the representation of the minerals of Canada at the Paris Exhibition of 1900, were referred to in the last Summary Report. These continued to occupy much of my own time in the early months of the year, for, in addition to the receipt and repacking of the exhibits as they came in, which was particularly attended to by Mr. C. W. Willimott, every detail of the installation in Paris had to be provided for in advance, in conformity with the plans received of the part of the Canadian pavilion that they were to occupy. Show-cases of various patterns had to be made, as well as special supports for the heavier specimens. Index maps, showing the localities from which each

mineral came, were printed and coloured, and series of cards, coloured differently for each province in the Dominion were also prepared.

Catalogue,&c.

As the specimens arrived at Ottawa they were examined and listed, and when the greater number had been despatched to Paris, the preparation of a descriptive catalogue was begun with these lists as a basis. The work on this catalogue was necessarily somewhat hurried, but a large amount of information was condensed in it. Owing to delays in printing, and to the necessity of publishing an edition in French as well as in English, a supply of the catalogues was not received in Paris until some time after the opening of the exhibition, but this could scarcely have been avoided under the circumstances. A pamphlet of a general and popular character on the economic minerals of Canada was also prepared for distribution in Paris, and large editions of this were printed both in English and French. It appears that there was a great demand for these pamphlets and for the catalogue, particularly for the French editions.

Arrangements for exhibit.

The collection sent to Paris was the largest and most comprehensive ever brought together in Canada for exhibition purposes, and it consisted exclusively of minerals of commercial value, either for export or for use in the country itself When it had been despatched, it was arranged that Mr. E. R. Faribault should follow in time to carry out its installation, in association with Mr. Willimott, while Mr. A. P. Low was to relieve Mr. Faribault at a later date, complete the attendance on the collection at the exhibition and supervise its packing and shipment in the autumn. During the progress of the exhibition at Paris, it was decided by the Minister of Agriculture that most of the exhibits should (instead of being returned directly to Canada) be sent on to Glasgow for the International Exhibition to be opened there in May next. This decision affected practically the whole of the specimens of minerals, and these are now, therefore, either in storage in Glasgow or on their way to that city.

Reports made by Messrs. Low and Faribault.

The following report on the mineral exhibit at Paris combines separate reports made by Messrs. Faribault and Low. The first part is entirely due to the first-named gentleman, while many of the notes referring to inquiries for certain mineral substances and possible markets have been supplied by Mr. Low. The joint report of these gentlemen will be read with interest. Particular attention may be directed to the large number of awards obtained by Canada in the mineral group.

Officers at Paris.

Mr. E. R. Faribault left Ottawa for Paris on the 15th of February, in company with Mr. C. W. Willimott, to superintend the installation of the collection of minerals from Canada.

The space allotted to the Canadian mineral exhibit covered about 3,550 square feet and occupied the greater part of the ground floor of the second wing of the Canadian pavilion, situated in the Trocadero gardens.

Installation of exhibit.

On arrival, the gentlemen named immediately began the erection of the necessary stands and cases to receive the various groups of minerals, the greater part of which had already reached the Canadian pavilion. The unpacking was then proceeded with, and the specimens were sorted and classified. The collection sent, filled over 325 boxes and barrels and the weight of minerals contained in these was in all about seventy tons. The specimens for the most part arrived uninjured, although many of them, particularly those of large size, required to be re-trimmed in order to expose fresh surfaces.

Character of exhibit.

The collection comprised over 1,200 separate exhibits, many including large suites of specimens representing associated minerals or various products. It was thus much larger than any shown by Canada at previous international exhibitions, embracing in fact twice as many localities as were represented in the Colonial and Indian Exhibition of 1886, or at the Chicago Exhibition of 1893 ; and, as a whole, it afforded a very complete representation of the economic minerals of the Dominion, so far as these are at present worked or known, from the Atlantic to the Pacific coast.

The arrangement adopted in installing the exhibits followed, as far as possible, that adopted in the descriptive catalogue of the collection prepared by the Geological Survey, by which the various minerals were primarily placed in natural groups according to composition and the purposes for which the several ores and other substances are employed. Each group was then subdivided geographically, the order followed being from west to east.

An analysis of the exhibits, as finally installed under the several classes and sub-classes of the descriptive catalogue, is given in the following table :— Exhibit of Canadian minerals.

	British Columbia.	Northwest Territories and Yukon.	Manitoba.	Ontario.	Quebec.	Southeast Townships.	New Brunswick.	Prince Edward Island.	Nova Scotia.	Total.
I. Metals and their Ores.										
Gold, alluvial	77	34	....		6					117
Gold, milling ores	81			73					30	184
Gold, smelting ores	110									110
Silver ores	6			3						9
Silver-lead ores	148									148
Silver-copper ores	12									12
Copper, native	1			2						3
Copper ores	100	1	....	6	6				13	126
Lead				6	1				6	13
Zinc				1	1					2
Platinum	3			2						5
Mercury	2									2
Antimony					1		1		1	3
Nickel				15	2		1			18
Cobalt	1									1
Iron					1				1	2
Magnetite	7			30	4	1			10	52
Hematite	1			17	3		1		11	33
Limonite and bog-iron ore	1				1		1		5	8
Other iron ores		1	....		3				1	5
Manganese							3		8	11
Chromite or chromic iron ore					7					7
Tungsten					1				1	2
Molybdenite	1			2	2	1			1	7
II. Materials used for Light and Heat.										
Anthracite coal		1	....							1
Bituminous coal and lignite	7	4	....				1		11	23
Anthraxolite				1						1
Albertite							1			1
Bituminous shales							1		1	2
Peat				1			1			2
Petroleum		1		4	1					6
III. Minerals for Chemical Manufactures, &c.										
Pyrites				1	3					4
Magnesite					1					1
Celestite				1	1					2
Strontianite				1						1
Lithia					1					1
Apatite				1	3					4
IV. Mineral Pigments.										
Iron ochres				1	1					2
Baryta					1				3	4
V. Salts and Brines.				5			1			6

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	Total
VI. Refractory Materials, Fire and Furnace Materials applicable to mfr. of, &c.	
[illegible]	3
Mica	16
Graphite	6
Fire-clay	2
Felsite	1
Felspar	4
[illegible]	3
Pumice	1
Talc	2
VII. Materials for Grinding and Polishing.	
Corundum	5
[illegible]	3
Infusorial earth	6
Garnet rock	3
VIII. Materials for Fine Arts and Jewellery.	
Cut and polished stones	40
[illegible]	1
Lithographic stone	2
Soapstone	1
Mountain cork	1
Amber (chemawinite)	1
IX. Materials Applicable to Construction.	
Granite, gneiss, &c.	15
Soapstone	15
Quartz-andesite	1
Breccia and conglomerate	4
Sandstone	25
Rotten stone	1
Limestone	27
Marble	35
Lime and cement	22
Shell marl	2
Gypsum	12
Brick and terra-cotta	5
Total	1233

Arrangement of cases, &c.

In carrying out the installation of the mineral exhibit, it was endeavoured, while following the general classification, to give prominence to the most attractive exhibits, as well as to the most important mineral products of the country; also to vary the arrangement of the specimens so as to present a generally pleasing appearance and to avoid the formal aspect of a permanent museum collection. With this

object in view, different kinds of stands, pyramids, trophies, monuments, tables-cases and upright cases had been designed to received the specimens, and on these they were arranged so as to obtain the best possible effect. The upright glass cases of British Columbian woods, made in Ottawa and shipped in sections, measured 12 feet long, 2½ feet wide and 8 feet high, and those designed for the mineral specimens had four superposed shelves extending their whole length and width. Special iron standards had been prepared in order to support the considerable weight of the shelves in these cases.

Gold exhibit.

The most prominent position along the central aisle of the mineral section was accorded to four protected steel and plate-glass cases which had been made specially to contain the large series of valuable gold specimens. This fine collection, valued at some $30,000, proved to be the greatest attraction of the whole Canadian pavilion and was constantly surrounded by an interested and admiring crowd of visitors.

British Columbia placer mines.

The British Columbian placer mines were represented by a large collection of nuggets, gold-dust and models of nuggets contained in two of these cases, which included also, for safe keeping, several specimens of gold-amalgam, platinum, arquerite, cinnabar and mercury from the same province. The exhibit represented the results of dredging as well as of sluicing, and included all the more important localities in the mining divisions and districts of Atlin, Liard, Omineca, Cariboo, Yale, Lillooet, East and West Kootenay, &c.

Klondike exhibit.

In the next case was displayed a fine exhibit from the principal gold-bearing creeks of the Klondike, including Bonanza, Eldorado, Hunker, Last Chance, Dominion, Sulphur, Gold Run, Eureka, Livingston, Forty-mile and Quartz creeks. This collection naturally attracted much attention from the fact that the fame of the Klondike is now wide-spread, and on account of the size of most of the nuggets and the explanatory statements printed on the accompanying cards, such as: "Gold dust value $61.19, one-tenth part of the amount recovered by four men sluicing for seventeen hours." One great attraction was a rosary lent by Rev. F. P. E. Gendreau, made entirely of nuggets in the rough from various diggings. A part of this case also contained fine gold dust from the Saskatchewan River, N.W.T., and samples of dust and models of large nuggets washed from the tributaries of the Chaudière River and from Ditton, Que.

Section of auriferous gravels.

Adjoining the Klondike collection and explanatory of it, was an upright glass-casing holding a section showing the whole depth (about sixteen feet) of auriferous gravels and other deposits from a part of Bonanza creek, and illustrating the actual conditions under which the gold is found in the Klondike. This had been obtained by Mr. R. G. McConnell. It was accompanied by a few explanatory notes in English

and French and could be readily understood by the general public. It proved very instructive and attracted much notice. Two other exhibits from the Klondike were large glass jars holding rich gravels with nuggets scattered through them.

Gold-bearing quartz from N. S.

In the fourth protected case were placed valuable and beautiful specimens of gold-bearing quartz coming from several districts of Nova Scotia. Most of these samples were small, but exceedingly rich, and contained nearly as much gold as quartz. The display presented a very fine appearanee and was much admired, especially by jewellers and mineralogists.

Milling ores.

The bulk of the milling ores were, however, contained in the first upright case on the east side of the central aisle and included large collections from Nova Scotia, Ontario and British Columbia; while some of the larger specimens from British Columbia and Ontario were placed on the gold pyramidal stand. Most of the Nova Scotian ones showed gold freely, and the specimens included samples of gold concentrates, associated minerals, wall-rock and 'barrel' quartz. Seventeen gold districts were represented, from the counties of Guysborough, Halifax, Hants, Queens, Lunenburg and Yarmouth.

Model of Goldenville gold district, N.S

In connection with the Nova Scotian gold and explanatory of the formation in which the quartz is found, was exhibited near by, in a large case, a model of the gold district of Goldenville, sent by the Geological Survey and made from plans and sections prepared by Mr. Faribault. The model is composed of ten rectangular blocks, seven inches square and thirteen inches deep, adjusted in two rows, and representing, when brought into contact, the surface plan of that district on a scale of 150 feet to one inch. By means of a key the blocks separate at will and present six transverse and three longitudinal sections to a depth of 2,000 feet, and clearly illustrate the 'saddle' structure, so characteristic of the Nova Scotian deposits and similar to that of the famous saddle-reefs of Bendigo, Australia. It shows that deep mining is possible by following well-defined zones of special enrichment through the succession of superposed veins.

Milling ores from Ontario.

The collection of milling ores from Ontario was very complete and represented a great number of localities from the gold districts to the north-west of Lake Superior, principally from the Lake of the Woods, Rainy river, Seine river, Michipicoten, Thunder bay and Manitou lake, and also from a few localities in the counties of Hastings and Peterborough. A large number of specimens showed free gold, but little of any associated minerals. Those from the Hastings district, however, showed much mispickel, pyrites, galena, tetrahedrite, copper-pyrites and blende.

The milling ores of British Columbia formed a large and varied collection from many localities, and included all the mining properties of any prominence being worked by stamp-mills, concentrating or cyaniding processes. Milling ores from British Columbia.

The collection of gold smelting ores came altogether from British Columbia. Some of the specimens were of considerable size and they covered the greater part of the gold pyramidal stand, 15 ft. long and 7 ft. wide. They presented a great variety of ores, classified as gold-silver and gold-silver-copper smelting ores, and altogether they formed a very prominent exhibit, especially admired by the technical visitors who made many inquiries concerning their extent, nature and treatment. The Rossland and Boundary districts were largely represented by gold-copper smelting ores, and included all the principal producing mines, among others the Le Roi and War Eagle, represented by extra large specimens, Iron Mask, Columbia-Kootenay, Centre Star, Nickel Plate, &c The Alberni, Clayoquot, Texada and Yale districts and several other localities were specially represented by specimens of gold-silver-copper ores. Gold smelting ores.

General information in regard to the extent and richness of the various gold fields of Cana la was given to many persons who had, or wished to make investments in mines of this character, with all the facts available in regard to particular mines or localities.

In close proximity to the collection of smelting ores, a fine exhibit was displayed from the Canadian Smelting Works, Trail, B.C., illustrating the processes followed in the treatment of the Rossland ores, consisting of samples of ores, fuels, fluxes, roasted ores, granulated mattes, flue-dusts, slags and high-grade copper-silver-gold matte. Illustration of treatment of Rossland ores

The Van Anda Copper and Gold Co. also had an excellent exhibit of gold-copper ores from properties on Texada island and gold-copper matte and copper, the products of their smelter.

The silver and the copper ores were exhibited near one another on the west side of the main aisle and filled two separate stands, one upright case and one flat case.

The silver ores proper consisted of but few specimens; some arquerite nuggets and models from Omineca and argentite from Slocan, B.C., also a few but very handsome specimens of argentite and native silver, from Thunder bay, Ont. Exhibit of silver ores.

The silver-lead ores all come from British Columbia and formed a large collection, the bulk of which was composed of large specimens of clean galena. Those coming from the Slocan district alone formed a very striking exhibit on a pyramidal stand, six feet square and five feet high. The rest of the collection filled more than half the upright Silver-lead ores.

case south of it and a small flat case, and it well represented all the other mining divisions of West and East Kootenay as well as localities in northern British Columbia.

The collection of silver-copper ores, especially valuable on account of their silver contents, completed the series of silver ores in the upright case. This again was entirely made up of specimens from British Columbia, and chiefly consisted of chalcopyrite, chalcocite, bornite, and galena from Nelson and from other localities in the West Kootenay, East Kootenay and Yale districts. The collection included a very complete exhibit from the Hall mines smelter, Nelson, illustrating the metallurgical work carried on at that place. It consisted of silver-copper ore from the Silver King mine, fuels, fluxes, mattes white metal, copper bar, anode, lead bullion and copper and lead slags. Altogether, the display of silver ores formed a very conspicuous and prominent feature and led to a good many inquiries particularly as to the silver-lead industry in British Columbia.

Galena ores.

The galena ores not derived from British Columbia generally carry small silver values, and these formed a separate series of lead ores in the above mentioned upright case. The collection was composed of specimens from Ontario, Quebec and Nova Scotia. Some special inquiries were made in regard to lead mines, but as a whole not much interest was exhibited in this metal.

Copper ores.

Great interest was taken in the exhibit of copper ores. and information was asked concerning the various copper mining regions, the size and character of the mines, the amount of output of smelted copper, prices, &c. Several inquiries were also made for copper ore from eastern Canada for shipment as such to European refineries. The collection of copper ores was exhibited beside the silver-ores and filled the upright case partially occupied by the latter, while the larger specimens also covered a pyramidal stand six feet square. The native copper-bearing rocks of the north shore of Lake Superior were represented by two samples and a fine sample of native copper from Atlin, B.C., was exhibited by Mr. Achille Daumount, Paris.

Variety of copper ores.

The collection of copper ores proper was especially remarkable for the great number of varieties included in it. British Columbia contributed a large exhibit representing all the best known mines and many localities yet undeveloped in East Kootenay, Yale, Cassiar and Vancouver island. It included chalcopyrite, bornite, malachite, azurite, cupriferous quartz, chalcocite and tetrahedrite. Ontario, Quebec and Nova Scotia exhibited smaller collections from such well-known localities as the Bruce mines in Algoma district, Ont., the South Ham and Harvey Hill mines in the Eastern Townships, Que., and the Coxheath mine in Cape Breton, N.S.

Next to the upright case containing the silver, lead and copper ores, was a large pyramidal stand fifteen feet long and five feet wide, both sides of which were covered with collections of the different iron ores, while the ends were occupied respectively by the nickel ores and the chromic iron ores.

The iron ores were divided into five series: magnetite, hæmatite, limonite and bog-iron ores, other iron ores and their products, iron and steel.

Magnetites.

The magnetite series was the most conspicuous, and included a good collection from Ontario, several specimens from British Columbia, Quebec and Nova Scotia, and one interesting specimen from the extensive deposits of Nastapoka island, east coast of Hudson bay. In the hæmatite series, Ontario and Nova Scotia were well represented, while British Columbia, Quebec and New Brunswick exhibited only a few specimens of limonite, bog-iron ores, clay iron-stone, ilmenite, titaniferous ores, magnetic sand and siderite from various provinces. Constant inquiries were made as to the extent and richness of the various deposits of iron ores, especially in the eastern portions of the Dominion, and the chances of the profitable exportation of such ores to Europe for smelting. Numerous inquiries were also made in regard to finished iron and steel, especially to the finer grades corresponding to Swedish iron, and the products of the charcoal furnaces of the Canada Iron Furnace Co. Much interest was expressed in the installation of the large furnaces in Nova Scotia now in progress and the likelihood of an export trade in iron to Europe from Canada.

Iron industry illustrated.

Adjoining the iron stand, Quebec and Nova Scotia had two interesting displays, illustrative of the iron industry in Canada. The Canada Iron Furnace Co. exhibited a cabinet of specimens from the Radnor Forges, St. Maurice, Que., consisting of bog-iron ores, lake-ore and different samples of charcoal pig-iron and of wrought iron, together with a series of photographs illustrating the dredging of the lake-ore deposits. The other exhibit was sent by the Nova Scotia Steel Co. New Glasgow, N.S., and consisted of many specimens of iron ores from Nova Scotia, imported magnetite from Cuba and hæmatite from the company's mine at Wabana, Newfoundland, samples of different s of coal and coke, pig-iron and a large collection of steel bars, angle irons, &c, of various sizes and shapes, cut in lengths of two feet. The whole made a very complete and representative display, illustrative of the mines, blast furnaces, coking plant and steel works.

Chromic ores.

On the steps at the west end of the iron stand, was shown a series of specimens of chromite, including concentrated ore and tailings from the recently operated chromic iron deposits of the Eastern Townships of Quebec. The collection attracted the attention of many metal-

lurgists, there being a ready demand for this ore if of sufficiently high grade.

Nickel-copper ores.

The nickel-copper ores occupied a prominent place at the east end of the iron stand facing the central aisle. With the exception of a few samples from Calumet island and Memphremagog in Quebec and St. Stephen, N.B., the ores all came from the Sudbury region and consisted of nickeliferous pyrrhotite and chalcopyrite with associations of bornite and niccolite. The exhibit from the Lake Superior Power Co , Sault Ste. Marie, Ont., included samples of ferro-nickel pig.

Exhibit of products of nickel-copper ores.

Close to this collection and facing the southern entrance, in the middle of the central aisle, was placed, in a large cabinet, a joint exhibit made by the Orford Copper Co and the Canadian Copper Co. The display was very attractively arranged in pyramidal shape, and did credit to the importance of the industry which it represented. Not only were the native ores and the refined products shown in numerous different forms, but the intermediate stages of roasting, smelting and refining were illustrated and the processes employed explained. Besides the ores, the exhibit showed various grades of copper-nickel mattes, slag waste, nickel oxides, nickel sulphides, different forms of refined nickel, including catodes and anodes and a very artistic railing, sixteen feet long and four feet high, made of solid nickel, valued at $5,000. The exhibit of nickel ores and smelting products received, next to the alluvial gold exhibit, the greatest amount of attention from visitors, and information was required not only as to the extent and value of the deposits but also as to the composition and mode of occurrence of the ores and their associated ores of platinum and palladium, and also in regard to the mode of mining and treating the ores.

Exhibit of coal.

Facing the southern entrance, on each side of the nickel exhibit, stood two large columns of coal, each over two tons in weight, one from the Nanaimo field, B.C., the other from the Sydney field, N.S. These together formed a fitting illustration of the excellent fuel resources of the Dominion on the Pacific and on the Atlantic seaboards. Nearby stood a large cube of coal surmounted by a pyramid of excellent coke from Comox, B.C., while the remainder of the collection of fuels from the west, formed a prominent trophy in an upright glass case, six feet square, and included large specimens of anthracite from Anthracite, Alberta, coal from Nanaimo and Thompson river, B.C., and from Canmore and Lethbridge, Alta., coal and coke from Crows Nest pass, lignite-coal from the Yukon district, N.W.T., and lignite from Souris river, Assa., as well as peat, from Welland county, Ont.

The Nova Scotian and New Brunswick coal exhibit occupied the lower shelf of an upright glass case placed between that last mentioned

and the iron pyramidal stand. It consisted of a series of specimens representing several collieries of the Sydney field in Cape Breton worked by the Dominion Coal Co., and the General Mining Association, the Pictou, Springhill, Joggins and Cumberland fields in Nova Scotia, and the Newcastle field in New Brunswick. With these were albertite and bituminous shales from Albert, N.B., oil-shales from East bay, Cape Breton, and peat from Northumberland county, N.B.

Demand for coal in [illegible].

The present high prices of fuel in Europe, with the prospect of an increasing demand and the diminution of supply, has caused attention to be turned to possible new sources from which coal may be obtained, and the Canadian exhibit representative of coal-fields on the Atlantic coast has led to many inquiries from continental dealers regarding the probable shipping of Nova Scotian coal to Europe. Conversation with gentlemen from all parts of Europe, engaged directly or indirectly in the coal trade, leads to the belief that the present great demand for fuel and the consequent advance in its price is only partly due to the storing up of large quantities of coal for naval purposes by the different European governments, the chief cause being the natural expansion of manufactures, the increased use of steam-generated electrical power and the constantly increasing mileage of railways. These causes are all permanent and the increasing demand promises to be constant, while the output of the European coal-fields has reached or is rapidly approaching its possible maximum. Almost daily inquiries as to Canadian coal were made at Paris by persons interested in the trade from France, Belgium, Germany, Russia, Austria, Hungary, Italy and other countries of Europe, and surprise was expressed that with the natural advantages of the coal-fields practically on the sea-board and at least 700 miles nearer to Europe than those of the United States, a large export trade in coal had not already sprung up. Such information as could be afforded was given, and the persons interested were put in communication with the various coal mining companies of Nova Scotia.

Pressed peat.

The exhibit of pressed peat from Ontario led to many questions, not with respect to the possibility of trade in that fuel, but rather as to the method of preparation and the success of the manufacture from a commercial standpoint.

Graphite

The graphite exhibit, consisted of specimens of the disseminated amorphous and columnar varieties from Ontario, Quebec and Nova Scotia. The Walker Mining Co., had a good exhibit of crude and manufactured graphite from Buckingham, Que., consisting of crucibles, nozzles and stove polish, and the Keystone Graphite Co., exhibited a series of different grades of prepared graphite from Grenville, Que. Inquiries were especially made with regard to the suitability of the Canadian graphite for the manufacture of crucibles.

Petroleum and its products.

The petroleum exhibit was composed of three collections, viz, two large jars of maltha and tar-sands from Athabasca River, N.W.T, three samples of crude petroleum from Gaspé, Que., and a large collection of crude and refined oils from the western Ontario fields sent by the Imperial Oil Co. of Sarnia. The last-named exhibit was very complete and comprised crude samples from the Petrolia oil springs and Bothwell fields, and no fewer than 59 products of refining and distillation, consisting of different grades of illuminating and lubricating oils, paraffin oils and wax, gas and fuel oils, benzine and naphtha. The products were exhibited as they are put up for the market as well as in special glass tubes. This exhibit attracted much attention, and concerning the naphthas, grease and wax there were inquiries, especially for deodorized naphtha and for gasoline for use in motor-cars. Many questions were asked concerning the Gaspé oil fields by persons holding stock in the Petroleum Oil Trust Ltd.

The second upright case on the east side of the central aisle was devoted to specimens of corundum, asbestus, ochres and miscellaneous metalliferous ores. The lower shelf showed an extensive collection of crude and concentrated corundum from Raglan, Renfrew county, Ont., together with a large series of various kinds of corundum and emery wheels, the products of experiments made by three manufacturers with the Canadian corundum at the instance af the Ontario Bureau of Mines, by which Bureau the exhibit was supplied. Considerable interest was shown in regard to this new source of corundum and the various emery wheels manufactured from it were a surprise to all visitors who appreciated the value of the material. It is understood that the exhibit has already led to commercial results in connection with this new Canadian product.

Asbestus.

Asbestus was shown as it occurs in the rock and cobbed, from the districts of Danville, Thetford and Coleraine, Que. A special exhibit of a series of manufactured products was also displayed by the Asbestos and Asbestic Co, Danville, Que., in a table case standing near by, consisting of different qualities of crude, fiberized and fibre asbestus and asbestic wall plaster. The superior quality of the Canadian product compared with that of other countries was recognized by the members of the jury, and a mass of long white and silky cobbed asbestus resting on large pieces of vein, exhibited by the Bell's Asbestos Co., became especially an object of interest. The whole display of asbestus, both crude and manufactured, met with a great deal of attention especially from naval and military men, and specimens were given to several persons who were trying to adapt this mineral to new purposes.

A part of the third shelf showed a collection of ochres from St. Malo, Que., sent by the Canada Paint Co., in the natural and ground state, and manufactured into paints of different shades. This exhibit attracted some little attention and a number of visitors, especially those from Great Britain, asked for information concerning the baryta deposits of Canada. Ochres.

The remainder of this case contained miscellaneous metalliferous ores not already exhibited elsewhere, and included the following :— Miscellaneous ores.

Blende or zinc ore from the Zenith mine, Ont., and from Calumet Island, Que.

Stibnite and other antimony ores from South Ham, Que., Prince William, N. B., and West Gore, N.S.

Cobalt bloom from Goat mountain, B.C., pyrolusite from King and Albert counties, N.B., and several specimens of pyrolusite and manganite from Tenny Cape, New Ross, East River, Pictou, Sydney and Stellarton, in Nova Scotia.

One specimen of scheelite, from Beauce county, Que., and one of wolframite from Margaree, Cape Breton. Information was given to several persons engaged in the iron industries in regard to manganese, chromite, and the above mentioned tungsten ores, for use in the manufacture of steel.

Several fine specimens of molybdenite from Grand prairie, B.C, Haliburton and Renfrew counties, Ont., Pontiac and Wright counties Que., the east coast of Hudson bay and New Ross, N.S. Inquiries in regard to this substance were directed rather to obtaining specimens for mineral cabinets than to its economic utilization.

Platinum ores, gossan and sperrylite with palladium ore from Vermilion mine, Algoma, Ont. These rare minerals were especially interesting to the scientific visitors. A great deal of interest was also expressed in the occurrence of platinum and mercury in British Columbia, and inquiries were made concerning their mode of occurrence and the extent and value of the deposits.

This case also contained an important exhibit of iron-pyrites and chalcopyrite, used as sulphur ore in the manufacture of sulphuric acid, from Renfrew county, Ont., and from the Eustis and Albert mines, Quebec., the latter worked by the Nichols Chemical Co., operating important chemical and fertilizer works at Capelton, Que. Sulphur ores.

The third upright case on the east side of the main aisle, contained the bulk of the remaining miscellaneous minerals, viz.:—

Magnesite from Bolton, Que.

Celestite from Leeds county, Ont., and from Chicoutimi, Que.

Strontianite from Carleton county, Ont.

Lithia mica (lepidolite) from Wakefield, Que.

Apatite from Lanark county, Ont., and from the counties of Labelle and Wright, Que. These interested scientific and industrial visitors, who where specially impressed with the beauty of the specimens, and the high percentage of phosphoric acid contained in the mineral.

Baryta from Wright county, Que., and Lake Ainslie and Middle Stewiacke, N.S.

Salt and brines.

Salt and brines formed an important group of exhibits from Windsor, Wingham, Exeter, Parkhill and Clinton, Ont., and from Sussex, N.B. The Windsor Salt Co., had a particularly attractive exhibit of different grades of salt on a special stand.

Fire-clay from Comox, B. C., and Brooklyn, N.S.

Felsite, also well adapted to the manufacture of fire bricks from Coxheath hills, N.S.

Felspar, natural and vitrified, suitable for the manufacture of pottery and glazes from Nipissing district, Carleton county, Ont., and Wright and Labelle counties, Que.

Steatite and potstone from Brome county, Que.

Talc, equal to the best imported French mineral, from Hastings county, Ont.

Infusorial earth from different lake deposits in Quebec, New Brunswick and Nova Scotia, as well as different grades of manufactured products known as 'fossil flour' and 'tripolite.' Numerous inquiries were made about this material, and there appears to be a considerable market for it in Europe.

Garnet rock from Wakefield, Que., used as an abrasive for special purposes.

Lithographic stones from Hastings, Ont., and Temiscaming, Que.

Lime and cements.

Lime and cements formed a large group of exhibits, principally from Ontario, Quebec, New Brunswick and Nova Scotia, composed of the raw materials used, such as limestone, dolomite, clay and marl and the products, limes and cements of different qualities and suitable for different purposes. Special mention may be made of cements exhibited from Owen Sound, Thorold, Queenston and Limehouse, Ont., and from Hull, Que.

Gypsum products.

Gypsum was well represented, including specimens of selenite, and calcined samples from Tobique and Hillsborough, N.B, and

Windsor, Newport, Wentworth and Enfield, N.S. The Albert Manufacturing Co., of Hillsborough, N.B., had a specially attractive exhibit, apart from the others, composed of a large stand covered with specimens of gypsum, and anhydrite, also fine samples of alabaster under glass globes and barrels of plaster of Paris as it is put up for the market. Bricks and terra-cotta of different kinds and shades, and the varieties of shale and clay used were exhibited rom Humber river, Milton, Beamsville, Ont., and from Laprairie and Montreal, Que. The Milton Pressed Brick Co. had a good exhibit of ornamental pressed bricks on a separate stand.

Polished gem stones.

The space at the north-east corner of the mineral section was devoted to the exhibits of building and ornamental stones, grindstones and mica. The collection of cut and polished stones applicable to fine arts and jewellery was exhibited by the Geological Survey and filled two flat cases along the central aisle. It was composed of a great variety of such stones from various localities in Canada, comprising agates, jasper, aventurine, sodalite, amazon stone, peristerite, serpentine, porcelanite, labradorite, grossularite, vesuvianite, asteriated quartz, tourmaline, zircons, porphyry, brecciated jasper, chalcedony perthite, dyssyntribite, amethyst, mountain cork and chemawinite or amber. The collection was much admired by the general public, and many special inquiries were made as to the possibilities of getting large supplies of sodalite, labradorite, brecciated jasper and jasper conglomerate for interior decoration, furniture and other ornamental purposes.

Building and ornamental stones.

Behind this collection stood a pyramidal stand six feet square, covered with a large and varied collection of cubes and slabs of building and decorative stones representative of the most important quarries and known deposits of Canada. The collection consisted of granite, gneiss, syenite, diorite, serpentine, quartz-andesite, breccia, jasper-conglomerate, sandstone, limestone, dolomite, marble and serpentine-marble of various colours and shades. Most of the specimens were six-inch cubes, with faces differently dressed and polished where the material admitted, while the slabs measured one foot by two feet and represented polished marbles. A large collection of paper-weights was also exhibited in a flat case, representing specimens of serpentine and marble. The stone exhibit was comnleted by a number of columns, bases and monuments of polished granite, gneiss, serpentine and marble, distributed through the section at the foot of the pillars and elsewhere.

Polished granites and marbles.

Of the long list of specimens of stones exhibited, the following may be specially mentioned :—A column of red granite from Kingston, Ontario, and base of gray granite; a card receiver and pedestal four feet high of red granite from St. Philippe, Que., exhibited by J. Brunet,

Montreal; two bases of gray granite from Stanstead, Quebec; a prominent and beautiful monument of red granite from St. George, N.B., exhibited by the Bay of Fundy Red Granite Works, which received special attention. Two polished columns of serpentine, dark-green veined with white, and five specimens from Melbourne, Quebec, as well as several specimens of serpentine from other localities were much admired. A cube of quartz-andesite from Haddington island, B.C., and a polished slab of jasper-conglomerate, from Bruce mines, Ont., attracted much attention. Other interesting specimens were, five well dressed cubes of sandstone from Sault Ste. Marie, Ontario; a monument formed of three different kinds of dolomite from St. Andrews, Tyndall and Lake Manitoba, Manitoba; a slab, one cube and three small specimens of serpentine marble of different shades of green, (Eozoon marble) from Grenville, Quebec; a column, base, slab and paper-weight of gray marble from Maniwaki, Quebec; a column, five slabs and four small specimens of marble from Dudswell, Quebec, some varieties resembling the black and gold Porter marble from northern Italy, and a slab and paper-weight of red marble from St. Joseph, Beauce county, Quebec.

Slates. On the wall behind the grindstone exhibit were arranged several samples of roofing slate 12 x 24 inches, from the New Rockland Slate Co.'s quarry, representative of the excellent slate deposits of the Eastern Townships, Quebec.

Inquiries made. The collection of building stones, slates, lime, cement, gypsum and bricks as above described, was the object of study for many persons engaged in the building trade, and all expressed surprise and admiration at the variety and value of the building materials available in Canada. Inquiries of a business character, were made chiefly for granite, gneiss, anorthosite, the various serpentines and other building or ornamental stones capable of being polished and used for decorative purposes. These elicited favourable comments and the addresses of the producers were given to a number of visitors.

Grindstones. Behind the building-stone stand was an exhibit of grindstones from Cumberland Basin, N.S., Gloucester Junction, N.B., and a 'pulp' stone, from Newcastle, N.B., used in the manufacture of wood-pulp and weighing over a ton.

Mica exhibit The mica exhibit made a particularly attractive display along the transverse aisle, the samples being framed on coloured cloth on upright stands. The great size of some of the specimens was especially remarked. The greater part of the collection was composed of the phlogopite variety or 'amber mica' from the counties of Wright, Pontiac and Labelle in western Quebec, and Lanark in eastern Ontario, where it is extensively mined, and exported mostly for elec-

tric use. Specially fine exhibits were sent from western Quebec by the Wallingford Bros. & Co., and Blackburn Bros. mines in Templeton, Rev. Mr. Guay's and W. H. Sills's mines in Wright township, and from the Vavasour and the Gracefield mines in Hull township. Good samples of the muscovite variety were shown from Yellow Head pass, B.C., and from the Villeneuve mine and the county of Saguenay, Que. One interesting exhibit of mica boiler- and pipe-covering was also sent by the Mica Boiler Covering Co., of Montreal and Toronto.

Constant demands were made for information as to the supply and prices of mica, chiefly by persons engaged in the manufacture of electrical machinery, and there is no doubt that the exhibition will prove beneficial to the owners of mica mines in opening up a market for this mineral in France and in other countries of Europe.

Reports, catalogues, pamphlets, &c

The south-west corner of the section was made the centre of information on all matters appertaining to the mineral resources of the Dominion. In a book-case was placed a complete set of reports published by the Geological Survey, the mining reports issued by the provincial bureaus of mines, and other literature connected with the exhibit. Several pamphlets prepared to accompany the Canadian mineral exhibit were placed on a table for free distribution. They were the Descriptive Catalogue of the collection of the Economic Minerals of Canada at the Paris International Exhibition for 1900, compiled by the Geological Survey; the Economic Minerals of Canada, prepared by the Director of the Geological Survey, both published in English and French; the Mineral Industries of the province of Quebec, by Mr. J. Obalski; Minerals for the Paris Exhibition, by Dr. E. Gilpin, &c. These pamphlets were very much appreciated and greatly in demand.

Survey maps.

A representative series of maps and plans published by the Geological Survey was also exhibited on rollers in a rack and on available wall spaces. Many gratifying opinions were expressed by the members of the jury and other visitors competent to judge, regarding the work performed and the publications issued by the Geological Survey of Canada, and they were especially impressed with the practical nature of the work accomplished.

Photographs, and transparencies.

The collection was also made attractive by a large number of framed photographs decorating the pillars and other suitable space, and by numerous transparencies on glass, filling the windows, and illustrating the various mining industries of the Dominion from the Klondike region to Nova Scotia.

Labels.

All the specimens of minerals and ores were neatly labelled with cards of different colours for each of the provinces, giving the catalogue number and the name of the specimen in English and French,

the locality from which it came and the name of the owner of the particular mine or property. One officer was also at all times in attendance in the mineral section and was constantly employed in answering inquiries regarding the exhibit and in giving information on other matters connected with the mining industries, as well as on the climate, geography, geology and the natural productions of Canada.

The exhibition was officially opened on the date appointed, the 17th of April, although very few buildings or sections had their installation nearly ready on that date, and many of the buildings were not even completed. The Canadian exhibit was, however, one of the most advanced, and it may be stated that the mineral section was sufficiently well arranged to be opened to visitors from the first.

Mr. Low at Exhibition.

Mr. Low arrived in Paris in the last week in June, and when he took over the charge of the Canadian exhibit he found that, owing to the delay in arrival of the official catalogue, considerable work remained to be done in order that the arrangement of the specimens might correspond with that of the catalogue. All the specimens had not at that time been labelled, and owing to the crowds attending the exhibition, work could be carried on only in the morning, so that the installation was in reality not fully completed in detail until the end of July. Mr. Low acknowledges the able assistance of Mr. A. K. Stuart, who proved of great value owing to his knowledge of British Columbia and the mineral resources of that province; while his familiarity with French and German enabled him to give much information to many of the visitors.

Mr. Low remained in charge of the exhibit until the close of the exhibition, and then superintended the repacking of the entire collection and its shipment to Glasgow for the coming exhibition in that city next summer. The packing was finished on the 14th of December.

Character of visitors.

Many observations made by Mr. Low are embodied in the foregoing pages. In addition, he states that the Canadian mineral collection was much larger and more varied than that from any other country, while the arrangement, classification and labelling were also superior to those employed in the displays made by other countries. The exhibit was specifically confined to the economic minerals of Canada, each specimen being a fair sample from some mine or mineral occurrence, and it attracted consequently the particular attention of practical inquirers. Many appreciative comments from visitors might be cited. A number of scientific societies and associations as well as groups of students or graduates from educational bodies made collective visits to the Canadian mineral court. These included both French and German organizations, but private inquirers interested in

mining and metallurgy, or in the supply of materials for industrial enterprises from all parts of the world were also numerous. Where items of information desired could not be supplied on the spot, inquirers were referred to the addresses of the producers represented in the collection, or to the Director of the Geological Survey in Ottawa. It is not too much to assume that the result of the Canadian mineral exhibit at Paris will be of great practical benefit to mining and its dependent industries in Canada.

Awards to Canadian exhibits.

The greater part of the Canadian mineral exhibit came under class 63, including the working of mines and quarries, while the products of metallurgical industries came under class 64, the lime, cement, plaster and bricks under class 28, and products of petroleum and brines under class 87.

The awards actually recorded to the Canadian mineral exhibits are as follows :—

6 Grand Prizes—

Geological Survey Department.—Minerals, publications, maps, models, photographs, &c.

Canadian Commission at the Exhibition.

Ontario Bureau of Mines, Toronto.—Minerals and publications.

Department of Mines of British Columbia.—Minerals and publications.

Department of Mines of Nova Scotia.—Minerals and publications.

Department of Mines of Quebec.—Minerals and publications.

10 Gold Medals—

Canadian Copper Co., Sudbury, Ont. (Two gold medals.)—Nickel ores and products.

Orford Copper Co., New York.—Nickel ores and products.

Canada Iron Furnace Co., Montreal.—Iron ores and iron.

General Mining Association Sydney Mines, Cape Breton, N.S.—Coal.

Dominion Coal Co., Glace Bay, Cape Breton, N.S.—Coal.

Le Roi Mining Co., Rossland, B.C.—Gold ores and products.

Montreal-London Gold and Silver Development Co., Montreal.—Gold ores.

Nova Scotia Steel Co, New Glasgow, N.S.—Iron ores and iron.

New Vancouver Coal Mining and Land Co., Nanaimo, B.C.—Coal.

18 Silver Medals—

Albert Manufacturing Co., Hillsborough, N.B.—Gypsum and plaster of paris.

Asbestos and Asbestic Co., Danville, Que.—Asbestus, &c.

Bell's Asbestos Co., Limited, Thetford Mines, Que.—Asbestus and products.

Crows Nest Pass Coal Co., Fernie, B.C.—Coal and coke.

Jack & Bell gold exhibit, Halifax.—Gold quartz from Nova Scotia.

Milne, Coutts & Co., St. George, N.B.—Granite monument.

Union Colliery Co., Limited, Comox, B.C.—Coal and coke.

Union Industrielle et Métallurgique de Labrador, Quebec.—Ores, &c.

Wallingford Bros. & Co., Ottawa—Mica.

Windsor Salt Co., Limited, Windsor, Ont.—Salt.

Walker Mining Co., Buckingham, Que. (Two silver medals).—Graphite crude and manufactured.

Hall Mines Smelter, Nelson, B.C.—Silver and copper ores and products.

Canadian Smelting Works, Trail, B.C.—Gold and copper ores and products.

Owen Sound Cement Works, Ont.—Cement.

Queenstown Cement Works, Ont.—Cement.

Battle Bros., Thorold, Ont.—Cement.

Toronto Lime Co., Limehouse, Ont.—Lime.

9 Bronze Medals—

Blackburn Bros., Ottawa, Ont.—Mica.

Coleraine Chrome Mfg. Co., Black Lake, Que.—Chromic iron and concentrates.

Mac Machine Co., Belleville, Ont.—Rock drill.

Milton Pressed Brick Co., Milton, Ont.—Bricks.

Nichols Chemical Co., Capelton, Que.—Pyrites.

Samuel Winter & Co., Moncton, N.B.—Yellow Head Pass mica.

Canada Paint Co., Montreal—Mineral pigments.

C. E. Fish, Newcastle, N.B.—Pulp-stone.

Key-stone Graphite Co., Grenville, Que.—Graphite.

Honourable Mentions—

Laurentide Granite Co., Côte des Neiges, Que.—Worked granite.

Eustis Mining Co., Eustis, Que.—Copper- and iron-pyrites

Fossil Flour Co., Bass river, N.S.—Tripolite, etc.

Canadian Peat Fuel Co., Toronto, Ont.—Peat.

Gold medals were also awarded to Messrs. Low and Faribault as collaborateurs in classes 63 and 64.

Description of exhibit by Mr. A. K. Stuart.

An excellent description of the Canadian Mineral Exhibit from the pen of Mr. A. K. Stuart, has appeared in the British Columbia *Mining Record* (December and January numbers). He speaks in highly appreciative terms of the work done by the Geological Survey in connection with the exhibit and of the pamphlets supplied for distribution, and in conclusion says :—

'To return to the mineral collection : Quite one of the most gratifying features has been the immense amount of interest taken in it by technical people. This was the more noticeable at the period (during the summer months) when a great many Germans were visiting the exhibition. Of all nationalities they seem to have the greatest thirst for information. The questions they put were all of a practical nature, and it was interesting to remark that few, if any, were without a special note-book for jotting down anything which appeared to be of the slightest value either from a commercial or scientific standpoint. Moreover, each one knew to a great extent, exactly what he wished to find out and wasted no time over the matter. * * * * Of course, in many other minor details it would be easy to profit considerably by the experience gained here in order to somewhat improve our system of advertising our mineral resources, but it is rather doubtful that, whatever changes are made at any other exhibition, any greater success will be obtained by our exhibit than has been gained here. The effort made to attract attention to Canada and its hidden treasures has had, as a result, that nearly all who have seen our exhibits have gone away with a totally different idea of our country and the importance of our resources than they had before. This in itself should be a compensation for the expense of making this Canadian exhibit the best mineral display here.'

Yukon District.

Work by Mr. R. G. McConnell.

Mr. R. G. McConnell was occupied during the winter of 1900 exclusively in work connected with the elaboration of his observations

Yukon district.

in the Klondike region. During the past summer he was again occupied in the exploration of this and other parts of the Yukon district, with interesting results, of which a pretty full preliminary account is given by him in the following report :—

'I left Ottawa on May 27, but was delayed at Skagway and White Horse for some days by the lowness of the water at the head of Lake Laberge, and did not reach Dawson until June 20. I was accompanied by Mr. J. F. E. Johnson, who acted as topographical assistant.

Examination of Stewart River valley.

'A few days were spent in the vicinity of Dawson, completing the geological mapping of the surrounding district, and in making a hasty examination of the principal producing creeks. On July 13, I started with one man and a pack-horse, for the mouth of Clear creek, a tributary of the Stewart, examining on the way the great gravel plain east of the Klondike hills, commonly described as the old bed of the Stewart. The mouth of Clear creek was reached on July 21, and on the 25th Mr. Johnson, who had ascended the Yukon to the mouth of the Stewart in a steamer, and the latter river in a canoe, making a track-survey on the way, joined me. Mr. Johnson returned overland while I continued up the Stewart to the Frazer falls, which were reached on August 3. On the return journey, a geological examination of the Stewart valley was made from the Frazer falls down to its mouth, and a few days were also spent on the Yukon between the mouth of the Stewart river and Dawson.

Indian river.

'After returning to Dawson, trips were made to the Indian river for the purpose of examining the reported gold-bearing conglomerates opposite the mouth of Quartz creek, and to the Coal creek and Cliff creek coal mines. The Yukon valley was also examined from Dawson down to the mouth of Cliff creek. On the way out a stop was made at White Horse, and a preliminary examination was made of the important copper belt recently discovered west of that point.

Production of gold.

'The Klondike gold-bearing gravels were described in last year's Summary Report, and as no important discoveries of new creeks were made during the season, it will be unnecessary to dwell on them here. The production of the old creeks and benches has been large and is expected to exceed the great yield ($16,000,000) of the preceding year, but as the full returns have not been received it is impossible to give the exact figures. The increased use of machinery, more especially steam hoists and thawing machines, has largely contributed to the result. No attempt has yet been made to work any of the concessions on a large scale, and very little preparatory work is being done on them.

'The gravel basin east of the Klondike hills, extending north-west of the Stewart to the Klondike river, was prospected in a couple of places during the season, but so far as could be learned with indifferent results. This great body of gravel, measuring from ten to fifteen miles in width and in places exceeding 600 feet in thickness, carries fine colours nearly everywhere, and there is a possibility that in places the gold may be found concentrated in paying quantities. The extent and thickness of the gravel deposit will however necessitate expensive prospecting work. The gravel consists principally of quartzites, hard schists and various kinds of eruptive rocks among which granite is conspicuous, and has been derived principally from the east and south-east. The sources of the contained gold must also be looked for in the same direction.

Dist. Cont. Gravel basin east of Klondike Hills.

Stewart River.

'The Stewart is one of the main tributaries of the Yukon. It rises in the unexplored Pacific-Arctic watershed ranges lying between the heads of the Peel and Pelly rivers, and flows in a general westerly direction towards the Yukon valley. From Frazer falls to its mouth, a distance of nearly 200 miles, it is a large stream, seldom less than 150 yards in width and often more than double this size. It is navigable throughout the season by ordinary shallow-draugh river steamers all the way to the Frazer falls. From the Mayo to its mouth, the current flows from three to five miles an hour with occasional accelerations on the bars. Above Mayo river, the current decreases to a rate of from two to three miles an hour and bars are almost entirely absent. At the Frazer falls, the Stewart flows for a third of a mile with great velocity through a narrow canyon bounded by vertical walls of hard quartzose schist. The word falls is a misnomer, as the grade in the canyon is fairly uniform and the total descent was estimated to be only thirty feet. Above the falls the river is interrupted by occasional short riffles for several miles, but, further up its course is reported to be clear to the main forks, a distance of about sixty miles, and up the north branch for a considerable stretch beyond. The east branch is reported to be a rapid stream constantly interrupted by rapids and canyons. The principal tributaries of the Stewart below Frazer falls are the McQuesten and Mayo rivers, both fair sized streams, and Clear creek from the north, and Crooked river, Lake creek and Scroggie creek from the south.

Stewart River.

Character of stream.

'The country bordering the lower part of the Stewart river is nearly everywhere of a mountainous character, and may be described as a high plateau deeply dissected by a multitude of wide and often interlocking valleys. The hills project above the valleys in isolated

Country bordering lower part.

Yukon district.

masses, in irregular shaped groups, and in well defined ranges. The outlines are generally rounded and the elevations range from about 2,500 feet to 4,000 feet above the main valleys. The lower slopes are clothed with a forest of spruce, poplar, birch, willow and alder. Above a height of about 2,500 feet the surfaces are usually bare. The bottom-lands of the Stewart often exceed two miles in width and are seldom less than a mile, and those of many of the tributaries, notably Crooked river and Lake creek are even wider. Below the mouth of Clear creek, the Stewart has cut a comparatively narrow rock-walled channel through the bottom of the older valley. The deepening of the valley is evidently due to the same elevatory movement that affected the Klondike region and evidences the wide extent of that uplift.

Character of valley.

Rocks exposed.

'The Stewart river valley affords a good geological section, but as the rock-specimens have not been examined yet, this can only be briefly described here. At the Frazer falls the river cuts through hard, quartzose, greenish schists, apparently partly crushed eruptives, alternating with bands of softer green chloritic schists and dark argillites. These schists, including in places beds and bands of quartzites, are exposed along the valley all the way down to a point five miles above Moose creek. At Canyon creek a hard slightly squeezed basic eruptive is included in the series, or overlies it. The dips as a rule are not high, seldom exceeding 45°, and the general strike is to the south-east.

Granitoid rocks.

'Above Moose creek, the schists are cut by granite, and granitoid rocks of various kinds occur along the valley down almost to Lake creek. The principal variety is a coarse-grained grayish granular rock consisting principally of orthoclase, a plagioclase felspar, (probably oligoclase) quartz and biotite. A reddish variety occurring above the mouth of the McQuesten contains a good deal of hornblende in addition to the biotite. At many points the granite becomes strongly porphyritic. The gray granite alternates with, and in many places appears to cut a dark eruptive of a dioritic character, but it is probable that the latter simply represents a more basic phase of the same magma. Both the dark-coloured and gray rocks are cut by a system of dark diorite dykes. The granites are massive in character and do not exhibit evidence of much squeezing.

Granite-gneisses.

'At the mouth of Lake creek, the granitoid rocks are replaced in the valley by a series of old looking schists largely of the character of granite-gneisses. They vary in texture from fine- to coarse-grained and often pass into augen-gneisses. They are associated with coarse mica-schists, green chloritic schists and dark hornblende-schists. The beds dip at high angles and usually exhibit the short sharp

foldings characteristic of the old Archæan gneisses. They have a width in the Stewart valley of about nineteen miles, and are probably a continuation to the south of the band of augen-gneisses described in last year's report as occurring on the upper part of Australia creek, but they have not been traced across. Similar granite-gneisses have been observed by Mr. Spurr* in the Forty-mile region, and by Mr. Brooks† on White river, and are described by them as being probably the oldest rocks in the district. The evidence on this point is not clear in the Stewart river valley, and there is a possibility that they represent a great intrusive mass older than the massive granites described above, but younger than the highly altered rocks exposed along the lower part of the Stewart valley.

Yukon dis

Age of

'The granite-gneisses are succeeded by a group of rocks which, so far as known, include the oldest sedimentaries of the district. The characteristic variety is a gray fine-grained gneissic-looking schist consisting largely of angular quartz grains with some felspar. Biotite is nearly always present, but in variable quantities. In many sections the schists have a banded appearance, due to the alternation in thin beds of a light-gray quartz-schist, carrying a few scattered biotite scales arranged parallel to the bedding, with a dark-gray more micaceous variety of the same rock. These schists are everywhere highly altered and in many instances are so completely recrystallized that their origin is doubtful. A preliminary examination of a few thin sections, shows that both clastic and igneous rocks are present, the former probably preponderating. The metamorphism has, however, been so complete over large areas that the two kinds are often indistinguishable in the field. In addition to the gray schists, the series includes bands of dark diorite-schists, green chloritic and actinolitic schists, bright lustrous mica-schists and numerous beds of white crystalline limestone. The strata just described occupy the Stewart valley down to its junction with the Yukon and are also found west of the Yukon on the lower part of White river where schists of an almost identical character have been described by Mr. Brooks‡ under the name of the Nasina series. This name will be employed by the writer in referring to these rocks. In the Forty-mile district the Birch creek series and the Forty-mile series of Mr. Spurr probably represent the same group, but no such line of division as that assumed by him could be drawn in the Stewart river section. The schists of the Nasina series apparently overlie the granite-gneisses which border them on the east. The dips are usually moderate, seldom exceeding 40°, and there is a marked absence

Sedimentary rocks schists and gneisses.

Nasina series.

Position of

* U.S. Geological Survey, Eighteenth Annual Report, Part III, p. 134.
† U.S. Geological Survey, Twentieth Annual Report, Part VII, p. 460.
‡ Ibid, p. 465.

Yukon district (cont'd).

of the sharp foldings so prevalent in the granite-gneiss area. The apparent superior position of the Nasina series and the small amount of deformation its rocks have suffered as compared with the granite-gneisses, leads to the inference that they are younger than the latter, but is not conclusive proof. The contact of the two formations was nowhere seen, and bosses of sheared granite, similar to and possibly of the same age as the granite-gneiss, cut the Nasina series at several points.

Eruptive rocks.

'The Nasina schists are cut in all directions by numerous dykes and stocks belonging to several distinct periods of eruption. The oldest are the sheared granites referred to above. A younger looking gray massive granite also occurs in dykes and considerable areas all along the lower part of the valley. A group of acid dykes, probably mostly rhyolites, crosses the valley a few miles below the eastern boundary of the Nasina schists. They have been silicified and mineralized to some extent and form conspicuous yellow and red bluffs along the north bank of the river for some distance. Dark andesitic dykes were also noticed in a number of the exposures.

Glaciation of Stewart valley.

'The glacial features of the Stewart valley are interesting, as the upper part is in a glaciated and the lower in an unglaciated region. At Frazer falls the rocks are strongly glaciated in a direction nearly parallel to that of the valley and groovings also occur at several points lower down. Typical boulder-clay occurs in banks at intervals down to a point about ten miles below Mayo river. Below Mayo river a wide ridge 200 feet in height crosses the valley. The ridge is several miles in width and is built of silts, sands and gravel alternating with and often capped by bands of boulder-clay. A narrow depression bordered by steep scarped banks has been cut through it by the river. This ridge must have formed at one period a great dam across the valley, as above it the flats bordering the river are low and the drift deposits occur only in narrow terraces along the sides of the valley. It still acts as a dam to some extent, as the Stewart is sluggish above the Mayo river almost to Frazer falls. Below the ridge, the boulder-clay and accompanying glaciated boulders soon disappear, but high terraces of silt, sand and gravel continue along both sides of the valley down to the McQuesten and are occasionally cut by the river at the elbows of the bends. A high cut-bank two miles and a half below the mouth of Moose creek includes a thick bed of hard sandy clay resembling boulder-clay but containing rolled, in place of glaciated pebbles. In the lower part of the valley the gravel banks, where they occur, consist entirely of ordinary stream wash.

Auriferous bars.

'The Stewart river bars were found to be auriferous as early as 1885, and in that and the two succeeding years it is estimated the yield

amounted to about $100,000. Prospecting has been carried on to some extent ever since, but the production has been small. Bars have been worked from the Mayo forks down almost to the mouth of the river. Steamboat bar, the richest bar discovered on the river, is situated about four miles below the McQuesten and is reported to have yielded for some time at the rate of $140 per day per man, as worked with a rocker. The gravels on this bar were auriferous to a depth of somewhat over two feet. In most of the other bars which were worked, the auriferous deposit was less than a foot in thickness, and was confined to a small area near the head of each bar. The extreme shallowness of the gold-bearing gravels accounts for the rapid exhaustion of the Stewart river diggings. During the past season no work of any kind was being done on the main stream below the Frazer falls. On the tributaries, some work was done on Scroggie creek, on some creeks near the head of the McQuesten, where some gold was taken out, and, late in the season, a strike was reported on Clear creek. A number of prospectors are wintering above Frazer falls and a good deal of prospecting will be carried out, on the upper waters of the river, during the coming season.

Yukon district

Character of

Prospectors

'The gold on the Stewart river bars is fine, and there is every reason to believe that it has been concentrated from the high gravel and sand banks described above as occurring along the valley from the Mayo down to the McQuesten. The gravels nearly everywhere contain scattered colours, and they are constantly being undermined and carried away by the river. During the past season a prospecting party under Mr. Morley Ogilvie, examined the lower part of the river for dredging purposes and the results are reported to be very favourable. The gold in the bed of the river proved to be coarser than on the bars and was found in encouraging quantities. The conditions on the river are favourable for dredging as the current, except in a few places, is not swift and the gravel is comparatively small with few large boulders.

Origin of river gold.

Gold in bed of river.

The Yukon River Section.

'The rocks outcropping along the Yukon river were examined with some care from the mouth of the Stewart down to Cliff creek, eleven miles below Forty-mile river. It was intended to continue the examination to the boundary but time did not permit. Below the Stewart the quartz-schists, crystalline limestones, hornblende-schists and other schists of the Nasina series, undulate in broad folds along the valley down to a point about four miles above Indian river, when they are overlain by the dark siliceous slates described in the Summary Report of 1899 as the Indian river series. The Indian river beds occupy the same position as the Nisconlith slates of southern British

Section of Yukon

Indian river slates.

Columbia. They rest, apparently, conformably on the schists of the Nasina series and differ from them principally in being less completely altered and in their darker coloration. They include occasional bands of limestone and green schist.

Klondike

'Two miles below Ensley creek, the Indian river slates are cut off and replaced by the light colored sericitic schists or squeezed quartz-porphyries of the Klondike series. The latter, holding in places irregular-shaped inclusions of the older slates outcrop, in continuous sections along the valley down almost to the Klondike river. They extend in a wide band south-easterly to Australia creek, and constitute, as stated in last year's report, the gold-bearing rocks of the Klondike district. The Klondike schists are succeeded by a set of green mostly diabasic rocks which the writer, for purposes of local description, has called the Moosehide group, and which are apparently older than the quartz-porphyries of the Klondike series. They occur both in a massive and schistose condition and are often altered into serpentine. Below Moosehide mountain, the section down nearly to Forty-mile river consists principally of thick bands of green schists and dark lead-coloured argillites alternating above with gray limestones. A few miles above Forty-mile river, the upper part of the Nasina schists and overlying Indian river slates are exposed for some distance in the axis of a broad anticline which crosses the valley in a diagonal direction. Below Forty-mile river the upper less altered green and dark schists resume and continue down to Cliff creek, where the examination ended.

rocks.

'In addition to the bedded or schistose rocks described above, igneous rocks in great variety are displayed along the Yukon valley section. Sheared and massive granites occur in considerable areas at many points and granitic and pegmatite veins are seldom absent. Effusive rocks are represented by an area of andesite below Indian river and a basaltic area a few miles above Forty-mile river. Dykes of andesite, basalt, quartz-porphyry and allied rocks are also common, especially between Indian river and Forty-mile river.

Lignite areas.

'Lignite-bearing beds outcrop on the Klondike river six miles below Flat creek and extend in a north north-westerly direction in a long narrow basin or series of basins to Cliff creek a distance of sixty miles and probably for some miles beyond. They follow in a general way the

On Klondike river.

course of the Yukon valley, from which they are separated by a narrow strip of the older rocks. Wide valleys are cut across them by all the streams entering this portion of the Yukon from the north-east, but owing to their soft character exposures are infrequent. In their normal

condition the beds consist of soft slightly coherent sandstones and conglomerates, alternating with light- and dark-coloured clays and shales. In places where the beds have been strongly folded, the clays and sands are altered into sandstones and shales. The age of the lignite beds is uncertain as no fossils were found in them, but they probably belong to the Tertiary.

Yukon Gold Co.

'A lignite horizon, with one or more seams, occurs in this formation at a number of widely separated points, and apparently accompanies it throughout its whole extent. Lignite seams outcrop on Rock creek and its tributary Coal creek at the northern end of the area, on Cliff creek at the southern end, and on Twelve-mile creek, Fifteen-mile creek and Coal creek at intermediate points, and is reported from a number of other localities. The total area underlain by lignite is estimated to considerably exceed 200 square miles.

Coal lands on Coal creek

'The Alaska Exploration Co. has taken up a block of coal lands on Coal creek, and has commenced mining operations at a point a little over seven miles from the Klondike river following Coal creek and Rock creek valleys, and about twenty miles from Dawson. Lignite outcrops at this point in the face of a low rounded hill, part of which has been cut away by the stream. The hill seems to be due to a recent uplift, as the dips of the strata approximately follow its slopes. The section on the exposed face of the hill consists of soft, slightly coherent micaceous sandstones and brownish clays, holding a broken bed of lignite. The workings of the mine consist of an incline about 400 feet in length, descending in a south-easterly direction at an average angle of about 25° for the first 200 feet, beyond which the angle gradually decreases to about 4°. A short drift has been driven in a north-easterly direction, following the seam, at a point 225 feet from the mouth of the incline. The seam dips to the north-east in the drift at angles of from 3° to 10°.

Workings on Coal [illegible]

Coal seam a Coal creek mine.

'The strata in the upper part of the incline have been disturbed and faulted to some extent, and the lignite beds occur in a broken condition. In the lower part of the incline and in the drifts, the beds are continuous although the dips are still irregular. The disturbance appears to have been quite local and will probably not affect the beds for any considerable distance. It is impossible, however, to speak definitely on this point, as no surface sections are available for study. Two seams of lignite are present in the lower part of the incline and in the drifts. The upper seam shows three feet of hard lignite, and the lower from two to three feet. The two seams are separated by a clay parting about a foot thick and are roofed and floored with clay. The lignite is hard and compact and shows no traces of the woody fibre so common in lignites. It is probable, as suggested by Dr Hoffmann, that it originated largely from mosses and other low forms of vegetable

trict—*Cont.* growth. It is of good quality, burns freely and can be used both for heating and steam purposes.

'The following analyses of the two seams have been furnished by Dr. Hoffmann :—

Lignite from upper seam Coal creek mine :—

Hygroscopic water	18·31
Volatile combustible matter	34·96
Fixed carbon	40·88
Ash	5·85
	100·00
Coke per centage (non-coherent)	46·73

Lignite from lower seam, Coal creek mine :—

Hygroscopic water	19·37
Volatile combustible matter	33·85
Fixed carbon	37·45
Ash	9·33
	100·00
Coke per centage (non-coherent)	46·78

'In working Tertiary lignites it is well to bear in mind that the seams as a rule are not so regular or so persistent as in the older formations and the use of the diamond drill for exploratory purposes is strongly recommended before commencing operations on a large scale. In the case of the Coal Creek mine the precaution is rendered all the more necessary by the almost complete absence of surface sections in the neighbourhood.

Cliff creek. 'The North American Trading and Transportation Co. has opened up a group of lignite seams at Cliff creek, a small stream which enters the Yukon from the right fifty-five miles below Dawson. The workings are situated about a mile and three-quarters from the mouth of the creek and consist of two long tunnels with a number of drifts and upraises. The lower tunnel is on the right side of the creek and the upper a short distance farther up the creek on the left side. The distance along the zone from the mouth of the first tunnel to the end of the second is 2,800 feet, and the seams appear to be continuous for this distance and probably extend much farther.

'The tunnel at the upper workings has been driven mostly along the lignite zone, for a distance of 800 feet. At one point, 225 feet from the mouth of the tunnel, the coal seams are bent to one side and probably faulted. The lignite zone, consisting of alternating beds

of lignite, clay and carbonaceous shale, measures over forty feet in thickness in places. The included lignite seams vary in thickness from a few inches up to five feet. A section 300 feet from the mouth of the tunnel showed over eleven feet of coal, in seams separated by clay partings and beds, as follows :—

Yukon district. Section on Cliff creek tunnel.

	Feet.	Inches.
Lignite	1	6
Thin parting—	—	—
Lignite	0	5
Carbonaceous shale	0	3
Lignite	0	6
Shale	0	1
Lignite	2	0
Clay	1	3
Lignite	1	3
Clay	3	0
Lignite	1	0
	15	10

'The beds have a nearly east-and-west strike and dip in a southerly direction at angles of from 50° to 75°.

'A section in the lower workings showed :

Section in lower workings.

	Feet.	Inches.
Shales		
Lignite, one thin parting	9	0
Shales	2	0
White clay	2	9
Alternating clays and shales	3	0
Grayish clay	13	0
Carbonaceous clay	3	3
Lignite, one parting	3	0
Carbonaceous shales and clays	6	0
Soft sandstone with layers of grit	10	0
	51	9

'The dip of the beds in the lower workings is much less than in the upper, and in places they are almost horizontal.

'The Cliff creek lignite is very similar in appearance to the Rock creek variety. It is dark in colour, compact, and probably somewhat harder than the latter, as the inclosing rocks are more indurated. Dr. Hoffmann describes it as a lignite of superior quality closely

Yukon district—*Cont.*

approaching to a lignitic coal. The following analyses were made in the laboratory of the Survey :

Lignite from upper and lower working, Cliff creek.
An analysis by fast coking gave :

	Upper Working.	Lower Working.
Hygroscopic water.....	8·57	10·58
Volatile combustible matter..	42·04	40·10
Fixed carbon.	45·77	46·74
Ash...	3·62	2·58
	100·00	100·00
Coke per cent.....	49·39	49·32

Analyses of lignite from workings.

Coke of lignite from upper working,—feebly coherent, tender.
" " lower working,—non coherent.

'A considerable quantity of coal from the Cliff creek mines was shipped to Dawson during the past season for heating purposes, and it is also used by a number of the river steamers with satisfactory results. The coal is sold on the wharf at the mouth of Cliff creek for $10 a ton, and in Dawson for $20 a ton, and upwards. A narrow gauge railway has been built from the workings to the river, and the mine is now in a condition to supply a large demand.

'The coal outcrops on Coal creek and Fifteen-mile creek were not examined. The Tertiary area on Indian river, opposite the mouth of Quartz creek is also reported to contain coal. The beds in this area are cut and hardened by igneous intrusions, and if they carry coal, it is likely to be harder and of a better quality than in the less disturbed districts.

Lignite seams on Lewes district.

'Lignite seams occur on the Lewes above Rink rapid, and during the last season a possibly important discovery of anthracite coal was made west of Dugdale station on the White Pass railway and only a few miles from the White Horse copper district. The specimens sent in for examination are crushed and coarsely foliated. The following is the result of an analysis made in the laboratory of the Survey :—

Analysis of coal from White Pass railway.

Hygroscopic water..	2·31
Volatile combustible matter....	5·59
Fixed carbon.....	67·20
Ash..	24·90
	100·00
Coke per centage (non-coherent.)	92·10

'The percentage of ash in the specimen assayed is high, but it is possible that a purer variety may be discovered in the course of the exploration now in progress.

White Horse copper deposits.

White Horse copper deposits

'The White Horse mineral area is situated west of the White Horse rapids on the Lewes river. The principal discoveries have been made along a belt about ten miles in length, running in a north-westerly and south-easterly direction or nearly parallel to the course of the Lewes and from two to four miles distant from it. The Lewes is bordered at this point, on the left, by a strip of rough plateau country closed in on the south-west by a range of mountains. The portion of the plateau adjoining the mountains may be said to constitute the mineralized district so far as known at present.

Geology of vicinity of White Horse rapids

'The geology of the district is simple, in its main features at least. West of the river and occupying the greater portion of the plateau is a lenticular area of gray often hornblendic granite. The eastern edge of the granite is mostly covered by drift, but on the west it cuts and often holds inclusions of gray crystalline limestone of unknown age. The limestones alternate with, and at one point are underlain by, hard flaggy ferruginous slates. Both the granites and limestones are cut by numerous dykes, which appear to belong to one period of eruption, but range from typical andesites and augite-porphyrites to a dark-green almost purely augite rock. A white or light-green dyke-rock is also common, composed almost entirely of epidote, zoisite, chlorite, secondary felspar and other alteration products. The granites opposite the upper end of Miles canyon are covered in places with basalts of the same age as those at the Canyon and White Horse rapids.

Mineralization of district.

'All the rocks mentioned above, except the basalts, have been affected in the mineralization of the district. The ore is seldom contained in well defined veins, but occurs as a rule scattered irregularly through wide zones and patches. These are often situated at the contact of the limestones and the granites, but are not confined to this position, as they occur frequently in the dyke-rock and occasionally also in both the granite and limestone. The most striking feature of the district is the great scale on which alteration of the country-rocks has been carried on. In many places zones or irregular patches a hundred yards or more in width have been almost completely altered, usually into a garnet-rock holding bunches of epidote, actinolite and tremolite and ores of iron and copper. Some quartz is also usually present, but this mineral is not prominent. The alteration and replacement of the country-rock and the attendant mineralization are evidently parts of

the same process and have probably been produced in most cases by ascending heated waters charged with the required materials Subsequent surface alterations of the ores from sulphides to carbonates and oxides, due to atmospheric agencies, are also conspicuous at most of the openings.

visited.

'Among the prospects visited and hastily examined, are the Puebla, Rabbits Foot, Anaconda, Copper King and Carlyle near the northern end of the belt, the Valerie at the southern end, and the Arctic Chief, White Horse, Empress of India and Spring Creek claims at intermediate points.

Puebla claim.

'The Puebla consists of a great mass of hæmatite of the specular variety, nearly fifty yards across, situated at the contact of the granite with the limestones and slates. The hæmatite is flecked all through with green copper-carbonate and in places with grains of bornite and grains and small bunches of chalcopyrite. The claim is opened up by a shaft 62 feet deep, and a drift from the bottom of the shaft 123 feet in length. The upper part of the shaft is in ore and the lower 32 feet in country-rock. The drift reaches the ore 23 feet from the foot of the shaft, and is continued from that point through almost pure hæmatite. Near the end of the drift a second shaft has been sunk to a further depth of 25 feet also through hæmatite. The lode at the shaft dips away from the granite at an angle of about 45°.

Origin of copper ore.

'The origin of this great mass of hæmatite and included copper minerals is somewhat obscure, but it appears to belong to the class of replacement lodes. No well-defined walls marked by fissures were anywhere noticed. On the contrary the ore passes gradually into the inclosing country-rocks, although the latter are of several kinds. On the foot-wall the transition is from ore to altered granite, and on the hanging wall from ore to slates and limestone. The replacement has been very complete, as only traces of the original rock remain in the main mass of the lode.

Copper King lead.

'The Copper King lead follows a wide fine-grained dyke, the character of which has not been determined, traversing the granite in a northerly and southerly direction. The dyke contains a number of small limestone inclusions and is filled with secondary minerals, among which garnet and epidote are conspicuous. The lead has been opened up by a number of shallow pits, all of which show more or less ore, for a distance of 200 yards. The ore is not continuous on the surface and appears to be concentrated at points where cross fractures intercept the main lead, and at the limestone inclusions. At the principal workings a shaft 18 feet in depth has been sunk near the contact of one of those inclusions. The dyke-rock at this point is almost completely replaced by garnet and quartz impregnated with grains and

bunches of bornite and chalcopyrite and occasionally with stibnite. The limestone to the east has also been well mineralized to a distance of twenty feet or more. A shipment of several car loads of ore which it is expected will run 14 per cent in copper will be made from this mine during the present winter. In addition to the copper tenor, the ore is stated to carry some values in gold. Yukon district — *Cont.*

'The Carlyle lead is situated about 300 yards east from the Copper King and is of a somewhat similar character. The workings consist of a shaft 50 feet in depth and a short drift along the lead. The ore consists principally of grains and bunches of bornite and chalcopyrite distributed through a gangue of garnet, quartz and country rock. The ore is banded in places. Carlyle lead.

'The Anaconda and Rabbits Foot to the north of the Copper King have both been developed to some extent. The workings on the Anaconda consist of an open cut and a short tunnel. The lead cuts through granite, limestone and a fine-grained light-coloured dyke-rock, and is fairly well defined. It carries green carbonate of copper, bornite and chalcopyrite and is reported to yield fair values in gold. The Rabbits Foot follows along a fine-grained dyke cutting the granite and holding some limestone inclusions. The dyke has been altered in places into a mass of garnet, epidote, hornblende, &c., usually carrying more or less green carbonate of copper, bornite and chalcopyrite. In addition to the copper minerals erythrite or cobalt bloom was found at one of the openings. The workings consist of a number of shallow pits. Workings on the Anaconda and Rabbits Foot.

'The Valerie is situated west of the head of Miles canyon. The lead occurs in a green basic dyke, consisting largely of augite, cutting limestone. The dyke has been mineralized in places for some width principally with magnetite and chalcopyrite. The chalcopyrite often occurs in bunches in the magnetite. A couple of surface openings and a shaft a few feet in depth constitute the workings. Valerie claim.

'The Arctic Chief, a couple of miles north of the Valerie, is situated in a wide porphyrite dyke cutting limestone and granite. The dyke-rock has been greatly altered and is now largely replaced by garnet, epidote, hornblende and other secondary minerals. Lenses of magnetite occur at several points. The largest of these has a width of fully 20 feet and carries chalcopyrite in grains, bunches and small veins. The workings consist of surface openings only. Arctic Chief claim.

The White Horse, to the south-west of the Arctic Chief, shows a fairly well defined lead 6 to 8 feet in width cutting granite. The gangue is more siliceous than usual and is heavily copper stained. The workings are confined to a single small surface cut. White Horse claim.

Yukon district *Cont.* Empress of India claim

'The Empress of India is situated about a mile north of the Arctic Chief in a confused area of limestone, porphyrite and granite now altered and largely replaced by garnet, epidote quartz, calcite, hornblende and tremolite. The altered area is fully 150 feet in width and carries in places grains and bunches, some of considerable size, of bornite and chalcopyrite. The Spring creek claim adjoining the Empress of India is similar in character. The work done on both claims is confined to surface openings.

'In addition to the claims referred to above, a large number of others have been staked along the mineral belt, and on a few of them a small amount of development work, usually in the form of shallow surface cuts, has been done.

'The district taken as a whole may be characterized as one of considerable promise, and as being well worth the attention of mining men. It is situated only 110 miiles from the sea with which it is now connected by rail, and the expenses of mining need not be much greater than in the camps of southern British Columbia.'

BRITISH COLUMBIA

British Columbia.

In the Atlin district, in the extreme north of British Columbia, Mr. J. C. Gwillim was again employed during the entire season available for field-work. His report upon the work accomplished and the present state of mining operations in this gold district is as follows :—

Work by Mr J. C. Gwillim.

'My instructions for the season were to complete, as far as possible the working out of the geology and topography of the Atlin district, already covered by reconnaissance survey during the preceding year.

'I was accompanied by Mr. W. H. Boyd, to whom was entrusted the topographical survey of the district under examination This work was carried out by him in an able manner, and the material for a sufficiently accurate map of the country between Teslin lake and Taku arm, including all the Atlin gold field, can now be compiled.

'We left Vancouver on June 1, arriving in Atlin on June 7. The season was somewhat earlier than in 1899, but the mountains were still covered with snow, so that we set about the lake work until conditions for mountain work became more favourable. The conspicuous peaks of Birch mountain and Mount Minto were taken as the limits of a base line on which to build up a triangulation of the district, and this triangulation was carried eastward to Teslin lake by Mr. Boyd. At the same time the local topography was fixed from each mountain station, and the geological features were examined as carefully as time permitted.

'From June 7 until July 10 was spent on Atlin lake, and its surrounding mountains. On July 10 we went over to Taku arm, returning to Atlin on the 19th, from which time we travelled with pack animals through the country between Atlin and Teslin lakes. British Columbia—*Cont.*

'After spending a week in the mountains adjacent to Pine creek, another man was engaged, and we set out for Teslin lake, by way of Ruby and Consolation creeks, thence north of Gladys lake, and down along the north side of Gladys river to its outlet into Teslin lake, some sixteen miles south of Dawson peaks.

'Returning, we crossed the Sucker river south of Gladys lake about two miles up from its mouth, thence proceeded up the Zenazie creek to within a few miles of Surprise lake and across a low pass southwards into the Terra Heena creek, which flows parallel to the Zenazie. In the report for last year this more southern stream was called Zenazie but the name Terra Heena appears to be the right one. From Terra Heena creek we crossed the upper branches of O'Donnel river and thence over another low divide into Wright creek and Pine creek basin on August 26. Routes.

'At this time Mr. Robertson, the provincial mineralogist, was examining the gold-bearing creeks, and I spent one day with him and Mr. Weir, on Spruce creek.

'On August 30 we began a circuit of the country lying to the southeast of Atlin, in order to trace up a probable extension of the gold-bearing slates of Wright and Otter creeks and to fill in the district between the Taku trail and our more northern traverses. This circuit followed Spruce creek and down Slate creek, across O'Donnel river, twelve miles from its mouth. Thence we went across the low massive granite range called McMaster mountain to the upper waters of the Silver Salmon river and Ruth lake of the older maps. Returning, we followed the great north-and-south valley of Sucker river for some fifteen miles, then crossed the low ranges west of it reaching Otter creek and Pine creek on September 19.

'The remainder of the season was spent in a closer examination of the conditions of the producing gold creeks in which I received much assistance from Mr. Frank Weir, of Stephendyke.

'On October 4 we left Atlin and reached Vancouver on October 11.

'A more detailed examination of the northern portion of Atlin lake brought out no facts of special interest. As stated last year, the shores are chiefly granitic, and without evidence of any mineral value, as far as observed.

'A set of soundings taken along midlake from Atlin, north towards the base of Mount Minto—25 miles—showed a general depth of about Depth of Atlin lake.

Explorations, Cassiar, *Cont.*

500 feet for the more southerly portion, and about 250 feet for the northern. The greatest depth found was 650 feet at a point ten miles north of Atlin.

Mount Minto.

'On July 4, Mount Minto was ascended, being almost clear of snow at this date. Its height is about 4,700 feet above the lake. The lower portion of this great isolated mountain, for 3,000 feet up, is granite. The upper portion and summit are composed of a dark, basic, eruptive, hornblende-porphyrite. Granite boulders were noticed on the highest points of this mountain. They are well rounded and are more acidic than the granite of the lake shore.

Atlin Mountains.

'The abrupt range of mountains immediately south of the Atlin river, known as the Atlin mountains, has a height of 4,390 feet above the lake, or 6,590 feet above the sea. The mountains were found to consist of quartzites, limestone and greenstone along the eastern base and flanks, with a core or interior mass of granite-porphyry similar to the other isolated areas of Birch and Cathedral mountains. The peculiar weathering of this rock has caused an immense slide of gray rock on the eastern face of Atlin mountains.

Cretaceous Rocks.

'South and west of the Atlin mountains is the first appearance of the sedimentary rocks on this lake, and these are probably Cretaceous in age. They are well shown in a rude anticline on the sides of two mountains. Observation of the different beds here exposed tends to show that the upper strata are of somewhat uniform material, usually a greenish sandstone, while the lower beds contain more conglomerates. The section as exposed here must be over 5,000 feet thick. No evidence of coal was observed in this possibly coal-bearing series of rocks. Neither are reports of coal and petroleum discoveries, so far as learned, well founded. A few fossils were collected along the lake shore. These appear to confirm the Cretaceous age of the series.

Eruptive rocks.

'To the west of Atlin lake is a high, well rounded group of mountains, composed chiefly of eruptive rocks of a basaltic and porphyritic character. They illustrate a common arrangement of the rocks in this district, having the older and often sedimentary rocks along the lower flanks of the mountains, while the central and higher mass is of eruptive origin, later in age than that of the Coast range granites.

General character of the geology.

'Generally speaking, the southern portion of Atlin Lake district consists of sedimentary rocks along the lower levels and lake shore, and sometimes for two or three thousand feet up the mountain sides. The main mass of these mountain groups, however, is eruptive and consist of various basalts, porphyrites and porphyries, both acidic and basic in composition.

British Columbia (Cont.)

Native copper.

'In some of the augite-porphyrites and allied rocks are found zones and seams impregnated with native copper. Such a condition is found on the Noel claim on the south shore of Copper island. The rock has been fissured, and now carries seams of quartz and calcite, with a zone of altered country-rock partly impregnated with copper. Other deposits of copper-pyrites and magnetite exist on the western arm of the lake near William creek. The chief development work done, on the quartz claims, has been on the Noel claim, otherwise there is nothing except a little assessment work done south of McKee creek. These creeks all flow over the eruptive rocks or Cretaceous sedimentaries characteristic of this locality, so far as known unproductive of gold.

'Moose creek flows in from the south over porphyrites and basalts of the Sloko lake character. It has been staked for several miles but is now abandoned.

Gold-bearing rocks.

'An extension of the magnesian gold-bearing rocks of Pine creek was traced westwards into Taku arm. These appear to continue westwards in a more broken manner and may be connected with the placer discovery on Graham creek near Golden Gate this season. They cease to constitute an important set of rocks, however, away from Atlin lake.

Mountains of Taku.

'The rather flat-topped group of mountains west of Taku on the north side of Taku inlet is porphyritic in character, and is flanked on the north by the extension of the Tagish Lake Carboniferous limestone. To the south of this eruptive area is the outcrop of the Pine Creek magnesian rocks, and further south the great mass of Cretaceous sandstones, which continues out to Golden Gate and the southern end of Taku arm.

Development work by Engineer Mining Co.

'Eight miles south of Golden Gate, on the eastern shore, the Engineer Mining Co. is developing the Hope mineral claim, under the superintendence of Mr. John E. Ryan. The ore-body is composed of quartz and has an extensive outcrop at the point of operation. The country-rock is a twisted clay-slate, a part of the Cretaceous sedimentary series, which at this place lies between the granites of the Coast range, four miles to the west, and a large area of porphyritic eruptives immediately to the east. Some acidic dykes were noticed in the vicinity, these being rare in other parts of the stratified series.

'The company was driving a cross-cut from the lake-shore to the ore-beds at the time of my visit. High values in gold are said to be found, and the presence of gold telluride has also been reported, but was not observed in specimens collected and examined in the laboratory of the Survey. Across the arm on the west shore another prospect is being developed, but this was not seen.

British Columbia—*Cont.*

'A belt of schistose rock follows the west shore down to and along Fantail lake. These are chiefly chloritic schists and appear to be mineralized by small quartz veins carrying some pyritic minerals.

'The route followed in going over to Teslin lake in August was taken in order to trace up the northern granitic boundary of the Pine creek series of rocks and their extension in a north-easterly direction. Also to determine the course of the Gladys or Thirty-mile river, which drains Gladys lake into Teslin lake.

Pine creek magnesian rocks.

'The Pine creek magnesian rocks and actinolite-slates have their northern boundary along the summit of Munro mountain, thence across the extreme head of Birch creek. From Birch creek it crosses to near Discovery claim on Boulder creek, and on Ruby creek the series is completely cut off by the granite which passes southward across Surprise lake.

'These Pine creek rocks re-appear at the upper branches of Ruby creek, but not very extensively. Proceeding north-easterly, much of the district is underlain by a quartzite rock, which has so far as known been unproductive of gold in paying quantities.

'The typical Pine creek rocks are again met with in the mountains south of Gladys lake. Here they are again limited and cut off by granites to the south and east. Apparently the great flats which lie west of Dawson peaks and north of Gladys lake are floored with quartzite rocks, which are in contact with limestones to the north and are probably conformable with them.

Gladys river.

'Gladys river is the name given to what has been called Thirty-mile river by the miners and on some earlier sketches and maps. This river leaves Gladys lake from its north shore eight miles from the western end. At the time of our traverse in August this stream was estimated at 60 feet wide by 2 feet deep flowing 4 miles an hour.

'The river has a canyon-like valley across a low range of quartzitic rocks flowing in a northerly direction for six miles. After crossing this low range into the great flats west of Dawson peaks, it turns abruptly to the eastward, and continues to flow parallel to this low range which separates it from Gladys lake. This course takes it through some large lakes with many islands, the chief of which is Hall lake.

'About five miles from its outlet into Teslin lake the Gladys river turns abruptly to the north again. At this point are falls of a few feet, causing the only portage necessary on the river for a strong boat. The point at which Gladys river enters Teslin lake is about sixteen miles south-east of the Dawson peaks or Three Aces.

'Nearly the whole length of the river-bed passes over quartzitic rocks, often cherty in character. Three miles from the mouth it crosses

limestone, which apparently underlies these peculiar quartzites. Much of the wide low country through which the river flows is underlain by gravels. British Columbia Cont

'Returning to Atlin, the traverse crossed the country south of Gladys lake. Most of this is roughly mountainous and granitic.

'The Snowdon group of mountains lies between Sucker river and Teslin lake. The north and south flanks of this group are quartzitic, the central and more prominent portions granite. So far as known no mineral discoveries have been made in this locality. Snowdon mountains

'The Sucker river was forded at a point two miles south of its entrance into the east end of Gladys lake. This river rises about thirty miles south of Gladys lake and lies in the same great north-and-south valley as the upper eastern branch of the Silver Salmon river. By this valley a low pass is formed from Teslin lake over to the waters flowing into the Nakina and Taku rivers and thence to Taku inlet, the greatest elevation being about 3,000 feet above the sea in the pleasant valley at the head of Silver Salmon. Zenazie creek flows into Sucker river from the west through a very rough group of granite montains that form the eastern extension of the Surprise lake granites. It is sometimes used as a route to Altin from Teslin lake, but has not much to recommend it. Sucker river.

'Excepting the small area of Pine creek rocks, south of Gladys lake, the block of country between Surprise lake, Terra Heena creek and Sucker river, is composed of a presumaly barren granite. The 'slates' re-appear at Terra Heena creek and south of it for many miles. Barren granite

'The district lying south-east of the Pine creek productive basin appears to offer some chance of an extension of the gold field in this direction. The characteristic rocks are often very similar to those of Wright and Otter creeks, but on the whole are more quartzitic. The presence of dark clay-slates of the Wright creek variety on Ptarmigan flats points to a still further development of these "slates" in a south-easterly direction. In this district there are many small creeks often with shallow bed-rock. These have been prospected very little and are not yet staked.

'McMaster mountains consist of granite, and constitute a massive easy-sloping range, between O'Donnel river and the upper Silver Salmon or Tawina. Farther south between the Silver Salmon and Ruth lake are the Merlin mountains. These are conspicuous and of a rugged character, green in colour and with many deep basins or cirques. They are composed of greenstone and serpentine, with some patches of black limestone, and are surrounded by quartzitic slates, clay-slates and crystalline limestone, characteristic of the O'Donnel river basin. The McMaster mountains.

British Columbia—

government Yukon telegraph line passes along the northern flank of these mountains on its way from Atlin lake to Telegraph creek.

Granitic plains.

'To the east of Merlin mountains and on the Taku trail are the great granitic plains or plateaus mentioned in last year's report. These extend in a northerly direction to within twelve miles of the granites of the Snowdon group, The intervening rocks being the widely spread slates, quartzites, clay-slates and patchy limestone.

Upper valley of Silver Salmon and Sucker rivers.

'The upper valley of Silver Salmon and Sucker rivers is in somewhat softer rocks, often approaching clay-slates. These are found in all the low ranges westwards towards the upper O'Donnel river and Wright creek. There are a few areas of gray limestone and some instructive rocks of the nature of greenstone. Some sluicing has been done on the eastern branches of O'Donnel river where the bed-rock is very similiar to that of Wright creek, but these claims are now abandoned, and at present no part of the O'Donnel river, or Dixie creek, is productive, but much of it is under hydraulic lease.

'The rocks of the entire district, as far as worked out at present, are roughly, as follows :—

Rocks of the district.

'1. Sandstones and argillites of probable Cretaceous age, in the basins of southern Taku arm and Atlin lake, with an expected continuation to the south-east by Pike lake, and the Nakina river.

'2. The characteristic rocks of Pine creek basin are different varieties of magnesian combinations, together with some greenstones of a diabasic character. Magnesite, serpentine, dunite, greenstone, actinolite slates and a very friable gray limestone are the chief rocks. These were not seen outside of the Pine creek and McKee creek basins excepting in two or three localities. They extend in patches across Atlin lake westward into Taku inlet and possibly over towards Taku arm to a point five miles south of Toochi river. Another area of these typical rocks is found about Chehalis creek, south of Gladys lake as mentioned previously.

'3. Cherty quartzites and various kinds of clay-slates, together with patches of gray or black limestone distributed over the great flats west of Dawson peaks and Gladys lake, O'Donnel River basin and eastwards to Teslin lake at its southern end.

'4. Great masses of crystalline limestones on northern Taku arm, Little Atlin lake, Lower O'Donnel river and at the junction of Silver Salmon and Nakina rivers.

'5. Late eruptive rocks of basaltic and porphyritic characters, all about the southern parts of Atlin lake, constituting the central portions of most of the groups of mountains there.

'6. Granites of the Coast range at the south end of Taku arm, and isolated masses of granite from the northern end of Atlin lake eastwards across Surprise lake, and Snowdon mountains to near Teslin lake, also McMaster mountains east of lower O'Donnel river, and the boulder-strewn plateaus seventeen miles eastward, from Ruth lake on the Taku trail. British Columbia—*Cont.*

'Concerning the auriferous gravels and placer mining; there has been no extension of the productive gold-field this season except the discovery of Graham creek, on Taku arm near Golden Gate, some portions of which are said to pay wages. Area of productive gold fields.

'On Pine creek and its tributaries much the same ground was being worked as last year, excepting where hydraulic leases have covered stretches of the creeks.

'Placer mining was active on Boulder, McKee, the upper portion of Wright, and the lower middle portion of Spruce creeks. Mining was also in progress from Stephendyke to Gold Run on Pine creek, and a few men were at the upper canyons of Spruce and other creeks.

'Most of Birch creek, the lower portions of Boulder and Wright creeks and portions of Willow and Pine creeks were under active hydraulic development. These, however, with the exception of Brackett's hydraulic concession on Willow creek, hardly got further than the preliminary stages of installing the plant and reaching bedrock.

'The other unoccupied portions of the above-mentioned creeks, together with various runs or supposed former channels and benches are under hydraulic lease. Apparently the chief difficulties are want of water, and some interference due to opposing interests.

'On Pine creek a considerable amount of work has been done along the southern banks from Gold Run down to Stephendyke. This has opened up a good deal of moderately paying ground, in the form of benches and older stream-gravels of different horizons.

'The existence of pre-glacial yellow gravels is shown at different points from Stephendyke to Gold Run, a distance of about two miles and a half. This old channel appears to be much wider than that of the present stream. Apparently it passed over the rocky benches between Stephendyke and Pine City, thence along the southern banks opposite the town and over the rocky bench which divides Pine from Willow creek. It is not so far shown in Willow creek itself, but follows Pine creek on both banks up to the mouth of Gold Run, which enters from the south as a boggy little valley. Apparently the yellow gravel follows Pine creek to a point above Gold Run as it is seen in workings. Pre-glacial gravels.

'A shaft sunk for 30 feet on the "Deadwood group," some distance up Gold Run, passes through a yellowish gravel, and good pay is

British Columbia—Cont.

reported from the rim or bed-rock at the bottom. Many men are planning to continue sinking along this possible old channel during the present winter.

'On the average it is said the yellow gravel hardly pays for ordinary placer mining, but not being cemented may be valuable for hydraulicing. It is stated that the Sunrise Gulch Hydraulic Co. took out $3,482 from an area 100 feet square on the yellow gravel bed-rock, at the head of Willow creek. A somewhat similiar but better defined yellow gravel deposit exists on Spruce creek and can be traced from above the lower canyon (at 101 below Discovery,) to the benches on the south bank of Discovery and somewhat higher up the stream. Its course and grade (between 2 and 3 per cent.) appear to be about the same as that of the present stream.

Yellow gravels on Spruce creek.

'The present stream flows between high banks of clay and partially sorted gravels, apparently of glacial origin, and the stream has cut down through these and the underlying yellow gravels, leaving the latter exposed at points. Many tunnels have been driven into the banks, with more or less favourable results.

Workings on Spruce creek.

'Prouse's tunnel penetrates the western bank near 100 below Discovery, and the yellow gravel excavated from its drifts is said to run $6 to the cubic yard. Active work and sluicing is being carried on at 94 below Discovery on the east bank in yellow gravel, and it appears that much of the gold found in the present stream-bed is a reconcentration from the older yellow-gravel channel, the bed rock of which is also the bed-rock of the present valley in places. Below the lower canyon the yellow gravel has not yet been traced, but there is some evidence to show that it may pass to the west of the cañon at Prouses point. These gravels are lost sight of both on Pine and Spruce creeks after the more level terraced flats are reached, and it appears possible that they do not now exist at a much lower level than that to which they have been traced.

Recent concentration.

'Besides the yellow gravels there are more recent concentrations along water courses which have existed during and since the deposition of the heavy drift which now fills the broad valleys of Pine and Spruce creeks. The regular depressions of Stephendyke, Gold Run, Willow creek, Thron gulch and several lateral courses have been at one time the channels of drainage for the waters of these valleys, and along them there has been more or less concentration of gold.

Hydraulic companies.

'The hydraulic companies which put in a complete plant and began operation during the past season are: the Syndicat de Lamare on Boulder creek, Atlin Lake Company on Birch creek, Pendugwig Syndicate on Wright creek, Sunrise Gulch Company on Pine and Willow creeks and Brackett's Willow Creek Company.

'Quartz mining has been undertaken to some extent by the Nimrod Syndicate, and by the Engineer Mining Company, the latter developing the Hope and Toronto claims on Taku arm. The Nimrod Syndicate has been engaged in developing and testing various prospects of promise within the Pine creek basin. Operations have been suspended on these, owing to various difficulties met with. British Columbia Quartz mining.

The Paris Exhibition claim belonging to the Imperial group is situated on Munro mountain. The vein being worked in July last, consisted of quartz and magnesite containing gold and silver values. The returns of mill-tests made by the Nimrod Syndicate, according to their published report were somewhat over $10 per ton. The strike of this vein is about east-and-west magnetic, dipping south at 70°. It varies in width from 2 to 7 feet and appears to be a well-marked fissure vein.

'The Yellow Jacket mineral claim contains a large vein or body of mixed magnesite and quartz, which outcrops along the bed of Pine creek about half a mile above Pine City. A shatt has been sunk by the Nimrod Syndicate, but work is suspended on account of litigation. The gold values of this rock are said to be high.

'Work is reported to have been carried on at the Canyon claim on Crater creek last winter. The vein carries galena and is said to look well.

'The Ivy May claim is situated at the head of Little Spruce creek and was being worked on September 22, when visited by Mr. Boyd. The vein is quartz, striking nearly east-and-west magnetic and dipping 60° to the south. High assays in gold are reported from this vein.

'By the opening up of bench gravels and the older channel gravels Bench gravel and old channels. during the past year, the extent of productive ground has been increased, so that the conditions for hydraulic mining at least, appear more favourable than they did a year ago. Some of this ground is rich enough for individual placer mining, and has the advantage of being workable during the winter by means of drifting. During the present winter a number of men are driving prospecting tunnels and drifts which will do much to reveal the older courses of the streams of these valleys.

'The greater portion, however, of this bench and yellow gravel appears better suited for hydraulic mining, as soon as the way is clear for operations.

'Specimens from the district examined in the laboratory of the Survey have failed to confirm the presence of tellurides or of nickel where they were supposed to exist. A light-green rock commonly stated to carry nickel in this district consists of magnesite and chromiferous mica. Some specimens of cassiterite (wood tin) from Klondike district were examined for Mr. Foster of Wright creek.

Mineral spring.

'A sample of water from the mineral spring at the north end of Atlin town was collected in order to prove, if possible, the relation of such waters to the hydromagnesite deposits in the vicinity. This has since been examined in the laboratory of the Survey and is reported upon as follows by Dr. Hoffmann :—

water.

"'This water was found to contain :—Potassa, traces ; soda, very small quantity ; lime, very small quantity ; magnesia, somewhat large quantity ; ferrous oxide, trace ; sulphuric acid, very small quantity ; carbonic acid, large quantity ; chlorine, very small quantity ; silica, trace ; organic matter, faint traces. The magnesia amounted, approximately, to 1·834 parts in 1,000, an amount which would correspond to 3·851 of magnesium carborate, or 5·869 of magnesium bicarbonate. It is more than probable that it is the water of this and similar springs in the vicinity, that the deposits of hydromagnesite occurring back of Atlin townsite owe their origin."

Mountain plants.

'During the season a collection of flowering plants was made, more especially of mountain species found above the timber-line on the bare grassy ridges. Fifty-four species have been determined by Prof. Macoun of which six are of special interest,—*Anemone Richardsoni*, *Pedicularis pedicellata*, *Claytonia sarmentosa*, *Pedicularis capitata* as also a *Claytonia* and an *Erigeron* which appear to be new. These are all mountain species from altitudes of about 5,000 feet above the sea, collected between June 21 and July 14.

'The common spruce of the district found of fair size in flats, is the white spruce, *Picea alba*.

'Acknowledgments are due to Messrs. Fraser and Wheeling, and to Mr. Gillard of the Bank of British North America at Atlin, for their courtesy and assistance during the season.

Work by Mr. R. W. Brock.

Mr. R. W. Brock has now been at work on the geology of the area covered by the West Kootenay map-sheet for some years. During the winter of 1899-1900 his time was chiefly devoted to an examination of the rocks from this field, and as a result of the field-work of the past summer the information required for the compilation of the map-sheet is now practically complete. The topography of this new map is chiefly due to Mr. W. W. Leach. Upon the work of the summer Mr. Brock makes the following interim report :—

'On May 22, I left Ottawa with instruction to complete, if possible, the work on the West Kootenay map-sheet, after which, if any time remained, to extend the geological observation westward toward the Boundary district. As in former years, I was accompanied by Mr. W. W. Leach, of this office, who took charge of the concurrent topographical work. The portion of the West Kootenay sheet still remaining

Topographical work by Mr. W. W. Leach

unsurveyed included, roughly, all the area lying between the longitude of Rossland and Lower Arrow lake, and the north fork of the Kettle river, from the International boundary line to about the latitude of Monashee mountain and the head of the main Kettle river, and also part of the area in the north-east corner of the sheet, east of Kootenay lake. British Columbia—*Cont.*

'The west shore of Lower Arrow lake, and Whatshan lake were not included, as these had been surveyed last year. The examination of these areas, with some degree of accuracy and detail, where the economic conditions seemed to warrant it, has been accomplished and it will now be possible to issue the complete West Kootenay map sheet. Owing to the large area embraced in the sheet, the extremely mountainous character of the greater portion of the country, and the complicated nature of its geology, the geological portion of the work, in many portions of the district must, however, yet be considered only reconnaissance work. Geological work accomplished.

'Although the season as a whole was unusually favourable, it was found impossible to do much more than complete the work on the West Kootenay sheet. Indeed, had the weather at the end of the season permitted it, some additional time might have been spent with advantage in this district. Some information, particularly topographical, was, however, obtained regarding the country to the west, which will be valuable in carrying on the work in the adjoining sheet.

'Before the regular field-work was undertaken, a few days were spent between Penticton and Grand Forks, in ascertaining some main facts respecting the distribution of the formations in the Boundary district, which were needed for the general geological map of Canada then in course of preparation. Work in the Boundary district.

'The regular work of the season was begun at Rossland. Using the Dewdney trail as a base for operations, the country between Rossland and Christina lake was surveyed. The work was then transferred to the district about Gladstone, from which point expeditions were made first east, and then north through Burnt and North basins to Badger and Gladstone mountains. Grand Forks formed the next base. From here the North Fork of the Kettle river was ascended. A wagon road, with branches to Volcanic, Pathfinder and Little Bertha claims, extends up the east side of the river to Knights camp on Cedar creek. From Cedar creek the North Fork trail continues to Bunch Grass mountain, where it forks, one branch ascending the main North Fork, while the main trail runs up the east branch of the North Fork to McKinley, Franklin, and Newby camps. After lightening the packs for our horses at Newby's, the end of the trail, we explored the country lying north through to Fire Valley. Fire Valley, and the Routes followed and areas examined.

British Columbia Coal

Kettle river, to the west as far as Monashee mountain, were next surveyed. From here Mr. Leach went to Crawford creek to fill in the blank remaining in the north-east corner of the sheet, while I ascended the Kettle to its head, to connect with the work of last year from Whatshan lake. Returning from the head of the Kettle to Fire Valley, the men were sent back to Grand Forks with the horses by the route we had explored, while I proceeded to Rossland *via* Arrow lake. From Rossland a trip was made to Old Glory mountain to complete the survey between Murphy and Sheep creeks. Returning to Grand Forks, where Mr. Leach rejoined the party, the North Fork was again ascended to Newby's, to complete the surveys of the trails, and of the Arrow Lake divide. When this had been completed the Columbia and Western railway (Canadian Pacific Railway) from Brown creek to the Bull Dog tunnel was gone over and a survey made of Christina lake. This ended the regular field-work of the season. A few days were spent on special work in the vicinity of Rossland and Nelson. Observations on Arrow, Slocan and Kootenay lakes, for the purpose of fixing their levels, were also taken. Ottawa was reached on October 31.

General description.

'As the map of West Kootenay embracing the area examined this summer, will soon be published, it will be unnecessary to go into detail regarding the topography of the particular area examined this season. While wholly mountainous, it is less rugged than the country to the east, its topography being that of an older district. The mountains are not so high and they have lost most of their alpine characteristics. Outside of the range between the main and east branches of the North Fork, few of the mountains exceed 7,000 feet in height. The summits, lying below the region of excessive denudation are more inclined to be dome shaped with gentle slopes. The ridges, noticably those between the head of the east branch, of the North Fork, Eagle creek and Fire Valley, are often wide and comparatively flat and plateau-like.

Physical features.

'As might be inferred, the valleys have departed more or less from the simple longitudinal and transverse system; the stronger creeks have invaded and captured territory formerly belonging to the weaker, thus complicating the structure of the valley system as well as that of the ridges. The latter system is rendered still more intricate by differences in resistance of the component rocks, more distinctly brought out by long exposure to denudation. Owing to these causes, peaks are found at the end of low ridges or rise unexpectedly in the valleys so that, viewed from an elevation, the topography, in many places, seems very complex.

'Near Grand Fork, and at a few other points, the mountains have drift-covered, grassy slopes, broken by brushy draws, through which knees and elbows of rock protrude. The Kettle valley about Grand Forks and Cascade is a prairie or park country, but with these exceptions, and that of the summits of the higher ranges, none of the country may be said to be open. British Columbia—Cont. Open country.

'The valley occupied by the North Fork and its eastern branch is remarkably level, rising only about 1,000 feet between Grand Forks and the mouth of Franklin creek, a distance of thirty-four miles. The main branch, however, rises rapidly above the forks at Bunch Grass mountains. It is evident that this valley was formerly occupied by a lake as the paralled valleys, Okanagan, Christina, Arrow, Slocan and Kootenay, now are. Formerly the North Fork discharged into the Kettle west of Observation Point, its present channel to the east being comparatively recent, as the gorge at the Smelter dam indicates. Were this dam about twenty feet higher, this river would again discharge through the western channel. Character of valleys.

'The main branch of the North Fork heads in a ridge south of Fire Valley, near Galloping mountain; the east branch, cut off at its head by Eagle creek, rises in a plateau with some smaller tributaries of Eagle creek, and Johnson creek which discharges into Arrow Lake.

'Christina lake, of which a log-survey was made, proved smaller than usually supposed, being little more than twelve miles long. Christina Lake and [illegible] to Kettle Valley.

'McRae creek, which discharges into Christina lake at English point, occupies a very narrow, steep-walled valley, heading with the south fork of Dog creek, which discharges into Arrow lake. These two creeks have cut away the neck formerly separating their cirques and now head together in a low pass (about 4,000 ft.). This pass, affording an easy entrance into the Kettle valley, has been utilized by the Columbia and Western railway.

'Fire Valley, through which the trail from Lower Arrow lake to Vernon runs, leads through two passes into the Kettle valley. Of these, one enters the Kettle valley near Kettle River bar, the other, which is followed by the improved trail to Vernon, opens on Kettle river, about six miles or so above the bar. The new trail after crossing Kettle river at Red Paddy's town-site, passes over the low ridge running south from Monashee mountain, joining the old trail in Pass valley about one and a half miles south of Monashee mine. Trails.

'About eight miles above the new trail-crossing, on Kettle river, is Keefer lake, a small sheet of water about one mile and three quarters long Three-quarters of a mile above Keefer lake is Pooler lake, a marshy lake three-quarters of a mile long, which may be considered Kettle River valley.

British Columbia—Cont.

the head of the main Kettle river. Several small streams from the hills north and south enter this lake. Only about one-quarter of a mile of flat, marshy ground separates this lake from Barnes creek, which flows south-east into Whatshan river, entering the latter about three miles from its month on Lower Arrow lake. A stream from the hill to the north, discharging into the head of Pooler lake, meanders through this marshy ground to within a few feet of Barnes creek, so that in high water it is probable that Kettle river and Whatshan waters intermingle. Barnes creek heads in the Cherry Creek Pinnacles, where Pooler creek, flowing eastward into the head of Whatshan lake, also takes its rise.

Vegetation.

'The vegetation is, generally speaking, similar to that already described in other portions of West Kootenay. The open hillsides are generally overgrown with bunch-grass, not commonly found farther east. The high open summits where vegetation can secure a foothold are gay in summer with sub-alpine flora. The valley of the North Fork to about Franklin camp is well timbered with red pine (*Pinus ponderosa*), white-pine (*P. monticola*) hemlock (*Tsuga Mertensiana*), cedar (*Thuga gigantea*), with some tamarack (*Larix occidentalis*), Douglas fir (*Pseudotsuga Douglasii*) and spruce. Some timber also occurs along the Kettle valley, but with these and a few other exceptions, beyond wood useful for mining purposes, there is little timber of commercial importance, since the greater portion of the district has been overrun by forest fires.

Game.

'In some portions of the country game is still plentiful, especially in the unprospected areas, such as the district between Franklin camp and Fire Valley. There numerous deer and caribou range, as well as animals of prey. The smaller animals are also plentiful. Game shot while in this rough region proved of great assistance in carrying on the work there.

Rocks observed in district.

'While granitic rocks cover the greater part of the district examined during the season, the range and variety of rocks represented is very great.

Serpentines.

'Going north from the Dewdney trail along the ridge between Sophie and Record mountains, for the first mile and a half the principal rock encountered is a brown-weathering serpentine. On a fresh fracture it is seen to be a compact, generally dark, green rock. The weathered surface is usually spherulitic. To the west of the summit of the ridge is a dark, heavy, partially altered peridotite-like rock which probably represents the parent rock through whose decomposition the serpentine has originated. A band of this serpentine runs north eastward across Ivanhoe ridge.

'From the northern border of the serpentine to Record mountain the rocks are fresh-looking volcanics, which, judging from their megascopic character, are andesites and porphyrites with accompanying agglomeratic tuffs. The rocks extend north of Record over Old Glory mountain, the dominant peak of this region. Dykes of porphyry cut all of the above mentioned rocks. British Columbia—Cont.

'The mountains at the head of Rock creek and the south fork of Murphy creek, are composed of the rock which has, in previous Summary Reports, been spoken of as the younger granite. It is a pink salmon coloured or reddish rock usually with large prominent crystals of felspar whose colour determines that of the rock. Frequently the cleavage planes of this felspar exhibit a beautiful iridescent sheen, such as labradorite often shows. Often more than one variety of felspar is to be noticed in the hand specimen. Biotite is usually a conspicuous component, hornblende may or may not be. Quartz is sometimes to be detected in considerable amount. In some of its characteristic developments this seems to be a granite, but it may show considerable range in composition. For the sake of convenience it will be referred to as the Rossland granite. Granites.

'Going south from the Dewdney trail to Sophie mountain, the rocks are a mixture of gray granite, serpentine and greenstone, the latter being apparently an augite-porphyrite or andesite. These rocks extend westward through the Velvet concessions to Sheep creek. The east side of Sophie mountain proper consists of a volcanic breccia, the base of which is an andesite-like rock, the included fragments are porphyrite, chert, argillite and crystalline limestone. The summit of Sophie mountain is capped by a conglomerate which extends west to within a few hundred feet of Sheep creek valley, and north to about the 'draw' between the Douglas and Victory-Triumph claims. The conglomerate is usually coarse, but fine grained grit bands occur. The pebbles which are generally a few inches in diameter, but which may be over a foot, are of quartzite, chert, argillite, serpentine and older conglomerate, while a few are of gray granite, sandstone and jasper. Along its western border, near the base, are some of a porphyrite-like greenstone. These latter are to be expected, as the conglomerate near Sheep creek rests on a brecciated porphyrite-like rock. This conglomerate resembles that found by Mr. McConnell south of Lake mountain, and no doubt both are remnants of what was once a continuous band of rock. Possibly a small outlier of Tertiary volcanics might be found overlying this conglomerate, as is the case on the North Fork of the Kettle river. Rocks of Sophie Mountain.

'All the Sophie mountain rocks are dyked, especially along the western slope, by light-coloured porphyries. In Sheep creek valley, south of the Dewdney trail, and on Santa Rosa mountain to the west, Greenstones and granites of Sheep creek.

British Columbia—*Cont.*

the rocks are also greenstone. But north of the trail to about Norway mountain, on both the Sheep creek slopes, and northward along the Sheep creek and Christina divide, from the Dewdney trail to the north of Mount St. Thomas, is a large area of the rock referred to as the Rossland granite. Near its contacts it becomes highly porphyritic, and then it resembles closely some of the larger porphyry dykes, of which, indeed, this younger granite is the parent rock.

Rocks of trail from Sheep creek to Cascade.

'From the Dewdney trail at the Christina divide, to the Boundary line, and westward along the ridge north of it, the rocks are very similar to those on the Sophie and Record mountain ridge, viz., a little gray granite, greenstones, with some argillites or phyllites, cut by porphyry, and dark lamprophyre dykes. Westward from the divide, the red (Rossland) granite extends to Bitter creek, holding near its western contact innumerable small inclusions of greenstone. From Bitter creek west to the ridge above Cascade (Castle mountain) the rocks are greenstone and more or less altered argillites, cut by acid and basic dykes.

'On Castle mountain ridge, south of the trail, the rock is a somewhat granitic rock, with greenstone down the Kettle river slope. About the Boundary line serpentine comes in, which across the line becomes almost noble serpentine. North of the Dewdney trail, on Castle mountain, is an area of serpentine, some of it finely mottled, of a dark-green colour, cleavable into large masses. In places this serpentine is fractured into lenticular fragments about 6 x 42 x 1½ inches. In these the serpentine is light green in colour, sometimes approaching the noble variety.

Rocks near Baker and Sutherland creeks.

'North of the serpentine the rocks are altered argillites and allied rocks, and porphyritic greenstones. The greenstones are often packed with inclusions of the argillites and limestone. A gabbro-like rock cuts the above, and between Sutherland and Baker creeks this is extensively developed. Along the south side of Baker creek is a belt of limestone, altered or replaced along the contact, and showing garnet and porphyritic greenstone.

Cascade to Coryell.

'North of Baker creek are greenstones, limestones, cherty quartzites and altered argillites, while along the summit between Baker and McRae creeks, is a coarse biotite felspar rock which closely resembles the Rossland monzonite. The greenstones and altered sedimentary rocks extend up McRae creek to within two miles of Coryell station, where the gray Nelson granite comes in but this rock does not extend far west of the creek.

Rocks near Coryell.

'The greenstone, with some limestone, extends north of McRae creek, up the basins of Day and Josh creeks, most of Burnt basin being composed of these. Dykes of the gray granite and porphyries

cut these rocks to some extent. A little of the monzonite-like rock is found in the Mother Lode claim. At Coryell, the greenstone crossing over to John Bull mountain, replaces the granite, but does not extend far north, being replaced two miles above the station by the gray granite which crosses McRae creek and forms the rock of North basin, and the country west to Christina lake. Badger mountain and the Arrow Lake divide north of it, is composed of the Rossland granite. British Columbia *Cont.*

'The rocks west of Christina lake are mostly crystalline, consisting largely of hornblendic and micaceous schists and gneisses with some crystalline limestone, extensively cut by and interbanded with pegmatites, and often more or less gneissoid granites. In places the gneisses appear to be crushed greenstones. Toward the north end of Christina lake, these rocks are largely replaced by a fine-grained acid granite, which is probably a facies of the Rosslandg ranite. The crystalline rocks extend westward along the Boundary line to the edge of the map-sheet, west of Grand Forks. Their northern limit, which may be taken as extending roughly from near the head of Christina lake to about the smelter dam at Grand Forks, is indefinite, as with the increase in size and importance of the granite dykes and pegmatites, the crystalline rocks gradually become less dominant and finally disappear even as inclusions in the granite. Rocks west of Christina lake.

'On the Christina and North Fork divide, near the heads of Boulder and Volcanic creeks, the granitic rocks, in which inclusions of the schists and crystalline limestone are common, vary from a coarse-grained granite to a fine-grained aplite, or a coarse pegmatite. The constituent minerals of the pegmatites have segregated on a huge scale, so that the area exposed of a single quartz or felspar individual may almost be reckoned in fractions of an acre. Where quartz occurs in such mass it may easily be taken for an immense quartz ledge. Inclusions of quartzite may possibly occur, and such inclusions, recrystallized as they would be under the conditions, would also be misleading. About the Smelter dam, on the North Fork wagon road, and in the mountains to the east, granite replaces the schist to a considerable extent. But one-half mile north, greenstone from the west side of the river crosses over, but does not extend far east, and the Rossland granite sends apophyses westward into it. Some altered limestone occurs with the greenstone. Coarse pegmatites.

'Between Mud creek and Knight's camp, just north of Cedar creek, the greenstone, with some limestone and gray granite, obtains a firm foothold east of the river. The eastern boundary runs east of north, crossing Volcanic creek just north of the Earthquake claim, to the east end of Pathfinder mountain, overlooking the south-west fork of Cedar creek. From Pathfinder creek the contact turns west of Contact between pegmatites and greenstone.

British Columbia. *Cont.*

north, recrossing the North Fork about one mile north of Cedar creek. The greenstone in some places contains numerous white crystalline limestone inclusions, in others it is filled with cherty quartzite fragments.

Granites and volcanics.

The gray granite in this area is, in places, quite extensively represented. East and north is the Rossland granite, which sends a number of porphyry dykes through the rocks of the above area. Lynch creek basin seems to lie entirely in this younger granite, but on the ridge just east of the North Fork, between Rock-slide creek and the east branch, is a series of volcanic rocks, consisting of dark blackish to purplish basalt-like, and brown porphyritic andesite-like rocks, with accompanying tuffs and ash-beds. These rocks probably constitute one of the Tertiary outliers, not infrequently to be met with on the Kettle river. Some gray granite occurs on the river-slope of the hill. Bunch Grass mountain, and the mountains east of the main branch of the North Fork, and the range constituting Arrow lake divide, are all composed of the Rossland granite.

Tertiary outlier.

Mineral-bearing rocks of Franklin camp.

'In the basin of the east branch, however, commencing at Desolation park and extending in width until including a large portion of the river slope, on both sides of the east branch, is a large area with an entirely different lithological composition. It is in this area that the various prospectors' camps are situated, which for convenience are grouped together and known as Franklin camp. In this area the gray granite and a dark porphyritic greenstone are the older rocks most frequently met with, some crystalline limestone and highly metamorphic rocks which may have been argillites, are also present. A gray gabbro-like rock cuts these on the west side of Franklin mountain, and on the eastern lower slopes of McKinley, Franklin and Tenderloin mountains, is a reddish porphyritic rock, with lath-shaped felspars, probably near a gabbro in composition. Capping the above rocks and forming the summits of all three mountains, are beds of sandstone, grit, and coarse conglomerate, overlain by volcanic rocks similar to those north of Rock-slide creek, already mentioned. The conglomerate is a hard well-cemented rock, with pebbles usually a few inches in diameter, but occasionally as large as two feet. The pebbles of the conglomerate are of quartz, gray granite, greenstone, black limestone, argillites and fine-grained conglomerate, with a few of a pink quartz-felspar rock, and a few of a purple sedimentary rock. The sandstone seems to form the underlying member of the series. In one or two places ash-like beds were noticed. The volcanic rocks consist of dark bluish and reddish basaltic rocks, sometimes with calcite and chalcedony-filled pores, reddish, grayish, and drab-coloured, porphyritic, andesite-like rocks, and some light-coloured rocks, possibly rhyolites (quartz phenocrysts are scattered through them), with beds

Conglomerate and volcanics.

of ash and tuffs. Similar volcanics cover a small area on the mountain a little north-east of the McKinley forks of the Franklin trail, above Younger's claim. The older rocks in this area, and to some extent, the conglomerates also, are cut by the light-coloured porphyry dykes, but in these volcanic rocks no such dykes were observed. British Columbia—*Cont.*

'From near the head of Gloucester creek to Fire Valley ridge, the rock is a pink quartzose biotite-granite, seemingly related to the 'Rossland granites.' Some inclusions of gray granite are occasionally met with, but except on the plateau at the head of the east branch, these are small and unimportant. Fire Valley ridge is composed principally of pink acid granite; the basin at the head of Goodwin creek, a branch from the north-east, is in the same rock, but north-west along the ridge gray granite comes in. Granites south of Fire Valley ridge.

'This gray, generally porphyritic, Nelson granite, is the principal rock of Fire Valley itself. It extents through to and across Kettle river, its northern boundary on the latter lying just above Paddy creek. North of this granite, from Monashee mountain, across the Kettle river eastward along the north side of Olds mountain and crossing Eight-, Ten- and Eleven-mile creeks, is a band of greenish, grayish and dark fissile rocks, consisting of quartzites, greywackes calcareous and slaty rocks and probably squeezed eruptives. These rocks are an eastern extension of the Cache creek series from Monashee mountain. This band is more or less cut up by gray granite-apophyses and numerous dykes of other eruptives. Rocks of Monashee Mountain.

'The Cache creek rocks extend up the Kettle river to within about one and a half miles of Keefer lake, where the black argillites of the Nisconlith series come in. These argillites extend to the head of Pooler lake where they gradually become altered, assuming a dark grayish, knotted, phyllite-like appearance. The rocks on Barnes creek are more highly altered, being drab, glossy phyllites and nacreous schists. Across Barnes creek on the west end of the ridge running east to Whatshan mountain, the rocks are still more crystalline, being drab, biotitic schists, with interbanded bluish gray limestone and a blocky micaceous quartzite having a perfect columnar cleavage. These rocks appear to grade without a break into the unaltered Nisconlith. The Nisconlith rocks run eastward from the head of the Kettle to a point on Barnes creek a short distance below the Eureka forks. On Eureka creek, in the black slates and soft dark calcareous rocks, are dykes of a dark brown eruptive, and also some black, crystalline, tuff-like bands, so that the series at this point bears an unusually close resemblance to the Slocan series of the east. These Nisconlith and Cache creek rocks are cut by the gray granite, and all these by porphyry dykes. Nisconlith and Cache creek series.

British Columbia — *Cont.*

'West of the North Fork of the Kettle, above Brown creek, on the Strawberry claim, the rock is an altered greenstone, serpentinized, epidotized and garnetized, which holds irregular inclusions of limestone, and possibly of other sedimentary rocks. Just south of the shaft-house, is a diorite-like apophysis from the gray granite. The greenstone extends south along the west side of the river toward Grand Forks. The rock-cuts on the C. & W. railway afford fine sections. In these, inclusions in the greenstone, particularly of limestone are seen to be exceedingly common. Often these inclusions take the form of long bands. When these bands are narrow, the limestone is apt to be white and crystalline, ; when wider, it is light coloured and crystalline only near the contact, being drab, blue or black and having marked stratification, in the centre. When cut by dykes the limestone is highly contorted or otherwise disturbed. Naturally its dip and strike is irregular, but frequently the inclusions of limestone take the form of rounded to angular white crystalline fragments, rarely more than a few inches in diameter, closely packed as in a pudding-stone, sometimes only the outside rim of the limestone pebble is crystalline, the core remaining dark and little altered.

Section on C. and W. railway.

Numerous limestone inclusions.

'Travelling south along the railway, the bands of limestone become more numerous and important until they form large rock masses. From one-thirteenth of a mile north of Mile Post 76, to three-sevenths of a mile north of Mile Post 75, the limestone is almost continuous. Fom here to almost one-third of a mile north of Mile Post 73, the greenstone obtains, often full of light green, epidotized fragments. (Sometimes only the periphery of the inclusion is epidotized.) From this point for the next half mile limestone is the prevailing rock. Some of this is pure and white, but irregular dark serpentine masses occur in it. From this area lime has been quarried, for use as a flux, by the Grand Forks smelter. From two-thirds of a mile north of Mile Post 72, to a short distance south of it, is a massive looking dark rock, in places full of pebble-like fragments of limestone, quartz, jasper, quartzite and slate. It has the appearance of being a conglomerate, but until the matrix has been studied it is impossible to come to a definite conclusion on this point. From the southern edge of this rock to the area of crystalline schists, the greenstone and limestone alternate.

'Except over the area of which the geology has just been outlined, little geological work was done, but a brief reference to the rocks noted in the hasty reconnaissance trip from Penticton to Grand falls may be made.

'East of Penticton the rocks appeared to consist largly of gneisses, cut by granite and pegmatites.* On the wagon-road west of Dry lake effusive rocks are met with. These consist mostly of dark purplish or reddish volcanic rocks with eyes of light coloured felspar, which are probably of Tertiary age. In them a little red porphyry was observed, but not *in situ*, so its relationship to the basalts can not be stated. These volcanics are also found east of the lake at the lower end. About Vaseau lake, on both sides, and continuing for some distance south, horizontally-lying gneisses are exposed. In this series dark hornblendic bands are interbanded with white-pegmatites.

British Columbia *Cont.*

Rocks east of Penticton.

'All around the Fairview forks of the wagon-road near Incasnup creek, the rock is a medium grained acid granite, consisting largely of felspar and quartz and a small quantity of coloured constituents. It weathers readily to a gravelly mass. Along the road to Camp McKinney, to the summit, the rocks are gray granite, (resembling the Nelson granite of West Kootenay), augen-gneiss derived from it and a fine grained gneiss with acidic and basic bands which is probably a more highly metamorphosed derivation of the same rock. From the summit to Camp McKinney and for several miles beyond along the Rock creek road, the rock is greenstone cut by granite and porphyry dykes. This is succeeded by basalts which continue almost to Rock creek, where, in the river bottom, the rock is again greenstone. A little above Rock creek on the Westbridge road, a quartzose grit of probably Tertiary age is encountered. One mile above Rock creek, dolomites, serpentine, argillites and greenstones, probably belonging to the Cache creek series, occur. After continuing about a mile, these give place to a conglomerate, probably Tertiary. The conglomerate is soon succeeded by more of the Cache creek rocks which continue to James creek. From James creek to Westbridge, and from Westbridge to Boomerang creek on the West fork of the Kettle, the dark purplish and reddish basalts (birds-eye porphryries of the prospector) obtain. From Boomerang creek to Ranch creek the rock is gray granite. From Rock creek to Beaverton it is mostly the reddish younger granite. At Beaverton is an important area of greenstone and some altered sedimentary rocks in the granite.

Rocks near Camp McKinney.

Camp McKinney to Beaverton.

'Going south from Rock creek the greenstone extends along the river bottom to the bend in the river. From this point almost to Boundary falls, volcanic rocks seem to predominate, greenstone forms the country rock from Boundary falls to Anaconda. Then the tongue of granite which cuts into the greenstone from the north, along Boundary creek, is encountered. About four miles and a half, north of

Rocks near Greenwood.

*Cf. Report of Progress, Geological Survey of Canada, 1877-78, p. 101 B.

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Greenwood, the railway leaves the granite, and greenstone is the principal rock to the North Fork of the Kettle river.

Relative age of rocks.

'The relative ages of the rocks met with this season, so far as known, are as follows:—The crystalline gneisses and schists are of uncertain age, probably they include rocks of different age, but they are, at all events, among the oldest rocks of the district. The Nisconlith rocks are Lower Palæozoic, supposed to be about Cambrian. The Cache creek rocks are Upper Palæozoic, probably Carboniferous. This is the age also assigned to most of the greenstones, (andesites, porphyrites, serpentines, &c.) and the limestones and argilites associated with them. Some of the andesite and agglomeratic rocks in the Trail creek district are no doubt younger, but there is no definite information regarding their age except that they are older than the conglomerates and the Rossland granite. The gray granite which cuts the greenstones is probably about Jurassic. The monzonite-like rocks appear to be younger than the gray granite, which would indicate that they belong to the Cretaceous.

Lake Mountain conglomerate.

'The conglomerates are amongst the younger rocks. The Lake Mountain conglomerate is supposed by Mr. McConnell to be Tertiary. It bears a strong resemblance, both lithologically and stratigraphically, to the conglomerates associated with the Tertiary volcanics on the Kettle river, which are supposed to be of Tertiary age. The Rossland granite, which sends dykes through the conglomerates both on Sophie mountain and on the Kettle river, is evidently younger than these. Dr. Dawson* has observed granite very much like the Rossland granite, cutting the Cretaceous rocks, in the Kamloops district. The Rossland granite, again, is newer than some of the basalts, as inclusions of the latter were found in it, and reddish porphyry dykes, seemingly identical with those from this granite, were observed cutting the lower volcanic beds. There seems good ground therefore for supposing this granite and the accompanying porphyries to be Tertiary.

Rossland granite

Basaltic areas.

'The effusive rocks of the basaltic areas are probably extensions of the Tertiary volcanics of the Kamloops and Shuswap sheets. Numerous basic dykes are newer than the Rossland granite and are probably from the same sources as the volcanic rocks.

Glaciation.

'None of the mountains in the district examined this season are of sufficient altitude to support glaciers or large snow-fields, but glacial phenomena, due to the former great Cordilleran glacier, are everywhere in evidence on the summits of the highest mountains, on the lower isolated ranges and in the valleys. Along the Boundary line they are as well marked as farther north. In the larger valleys and

* Annual Report, Geological Survey of Canada, (N.S.) vol. VII., 1894, p. 241B.

on the mountain slopes, are drift deposits, often terraced. Boulders of foreign rocks are scattered everywhere, occupying positions they could only have reached through ice transportation. The surfaces of the rocks, where they have escaped severe weathering, are fluted, polished and striated. The direction of ice movement, as indicated by transportation and striation, averages about S. 17° E., though varying from local causes from S. 1° E. to S. 45° E. British Columbia — Geol.

'Over a considerable portion of the district examined during the season, prospecting and development work were being actively carried on, but none of the camps were beyond the initial stages in mining. A great many claims were examined, but since a statement of the amount of work done and such facts and figures are given annually in the Report of the Minister of Mines for the province, such statistics need not be duplicated here. Reference, however, may be made to a few of the claims in each district, to illustrate the conditions under which the ores are found in these particular localities. Prospecting and development.

'On the west slope of Sophie mountain are the Velvet and Portland claims, The country-rock, principally greenstone and gray granite, is cut by parallel pink porphyry dykes which run almost due south from the large Sheep creek area of Rossland granite. These dykes are usually large and often lie close to each other with a narrow dyke-like band of greenstone or gray granite between, that might easily be mistaken for a true dyke in the porphyry. Mineralization due to porphyry dykes.

'Along the contact with the porphyry dykes the adjacent country rocks are fissured, altered and often wholly replaced. In these fissures and replacing the country rocks, in favourable spots on a large scale, are deposits of chalcopyrite, pyrite, hæmatite, calcite and quartz, sometimes possessing a distinctly banded structure.

'On the Velvet, where development work had reached the 300 foot level, a large body of auriferous chalcopyrite had been disclosed, and it is expected that this property, with the Portland, operated by the same company, will soon be in a position to commence shipping, The porphyry dykes continue southward into the conglomorate area, where the same contact phenomena are observable. The Douglas claim furnishes a good example of this. Along the porphyry contact, the conglomerate is mineralized and replaced for a considerable distance from the dyke. All stages in the replacement may be seen, from the unaltered conglomerate, away from the dykes, through the partially replaced matrix, to replaced matrix, attacked pebbles to replaced pebbles, and to the solid banded ore near the dyke. The ore is pyrite, galena, hæmatite, chalcopyrite and sphalerite, in a calcite and quartzy gangue. It will be noticed that the Sophie mountain deposits, while occurring in somewhat different rocks and showing some difference in mineralogical composition, are similar in their nature and origin to the Rossland ore-bodies. Porphyry dykes at the Velvet mine.

British Columbia—*Cont.*

'East of Christina lake, more particularly on Sutherland and Baker creeks, the rocks are in places heavily mineralized with iron sulphides and some chalcopyrite. The gabbroidal rock, as well as the ordinary greenstone, is mineralized. The limestone, as a rule, is only slightly so, but along the contact between the limestone and the greenstone, in the altered garnetiferous rock, mineralization seems to be particularly likely to have taken place. While the ore is said to be very low grade, some of the sulphide bodies are large and are on that account worth testing.

Sulphides, east of Christina lake.

'On the Cannon Ball there is a steam hoist, and some work has been done, but beyond this, no work of a serious nature can be said to have been attempted. The area between Christina lake and the Rossland granite of the Sheep creek divide should be carefully prospected.

Claims near Gladstone.

'The serpentine spoken of, already may prove of some value as ornamental stone. Gladstone, on McRae creek, is the centre of an area of the older rocks showing wider-spread mineralization. On the mountains to the east of Gladstone, and north of Mount St. Thomas, the greenstone and gray granite are more or less mineralized, usually near the porphyry dykes. On the Talisman claims is a magnetite showing strong polarity. It has probably resulted from the oxidation of pyrite, which is also present. The gray granite furnishes some very pretty specimens of chalcopyrite.

Claims in Burnt and North basins.

'In Burnt and North basins, lying west and north-west of Gladstone, the rocks show the effects of great stresses. Owing to the diversity of rocks and consequent varying powers of resistance, the region is much broken and faulted. It is extensively dyked by porphyries from the surrounding areas of 'Rossland' granite. Owing to these causes mineralization is widespread, but often lacks concentration. On some of the properties, however, there is quite a fair showing, and if the ore carries the reported values, they are worthy of some attention. But for successful development, careful and intelligent supervision is indispensable. Free gold in quartz veins is found in both the greenstone and gray granite. Below the zone of atmospheric and ground-water weathering, a considerable amount, if not all the gold, will probably be found to be held by sulphides. The Mother Lode may be taken as a type of some of these deposits. The main vein, which is about two feet wide, lies in crushed and banded greenstone, between two large dykes of porphyry. The ore is principally quartz, carrying pyrite, sphalerite and galena, with a little chalcopyrite. Native copper is said to have been found in this as in some other claims. The oxidized ore at least, furnishes specimens of free gold. A little molybdenite and some calcite are also present. An incline on the vein is down 43 feet, from the bottom of which is a 75-foot drift. About 20 feet down the incline the vein faults. In the drift, ore, supposed to be part of

the same vein, is again caught. Several veins occur on the claim. At the south end of the claim the greenstone is full of little stringers of zinc blende. British Columbia—*Cont.*

'On the Tammany claim, is a vein of quartz of varying width, sometimes several feet. It lies along the contact of a light-coloured porphyry. Galena and sphalerite become more prominent in the southern portion of the basin. Cooper's claims, on the south fork of Josh creek, have a dark fissile limestone as the principal country rock. The mineralization is often parallel to the fissility of the limestone, and frequently follows the contact of a dyke. Sphalerite, galena and chalcopyrite are the principal economic minerals, with a strong preponderence of sphalerite. One vein of pure sphalerite attains a thickness of about a foot. Little more than assessment work was being done in the Gladstone district.

'In places the crystalline rocks, between Christina lake and Grand Forks, are mineralized to some extent by pyrite and pyrrhotite. The pegmatites grade into quartz veins and carry a little mineral. At a few points a little work has been done. A number of specimens were collected to be assayed for gold, as the quantity of material available and the accessibility of the region would enable rocks with a low tenor to be successfully treated. Mineralization of crystalline rocks.

'Up the north fork of the Kettle, on the east side, little mineralization of consequence was seen till the area of older rocks about Volcanic creek was reached. There several prospects upon which considerable work has been expended, are situated. Just north of Volcanic creek, on Volcanic mountain, one of the landmarks of the country by reason of its highly coloured surface, is the claim best known as the Volcanic. Volcanic claim.

'The iron oxide which stains the whole side of the mountain and gives its colour to the soil below, comes from the oxidation of pyrite and probably other iron sulphides, whith are exposed on the top of the cliff. The rock here is a mixture of limestone cut by greenstone, (probably a porphyrite) altered and partially replaced by the iron sulphides. The limestone, which is also altered, is not so heavily mineralized. Below this, and forming the western face of the cliff, is several hundred feet of bedded limestone, with intercalated dykes, squeezed and contorted, probably by the porphyrite which cut it off. This limestone is not mineralized. Below the limestone the greenstone is again found. Into this greenstone, near the base of the cliff, hundreds of feet below the exposure of sulphides and separated from it by the belt of barren limestone, a tunnel had been run, which at the time of my visit was 700 feet long, with the expectation of striking the lead at great depth. The ore exposed at the top of the cliff is said to be very low grade, but such a strong showing is worthy of careful examination,

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which can be most effectively and economically accomplished at the point where the ore is known to occur.

Eagle claim.

'A short distance to the east and a little to the south of the Volcanic is the Golden Eagle claim. It also lies in the greenstone, which here contains small fragments of crystalline limestone. Two large wide dykes of porphyry, from the north east, cut the greenstone, and along the western contact of the west dyke, the Golden Eagle vein is found, The greenstone has here been altered by silicification and pyritization. The pay-chutes are two narrow veins of saccharoidal calcite and quartz, bearing chalcopyrite, pyrite and probably arsenopyrite In places the veins widen to about seven feet, by the replacement of greenstone with vein material. Even down to the deepest workings (150 feet) the sulphides are oxidized to iron oxide, malachite and chrysocolla. A little native copper has also been found. Some small shipments of ore were being made to the Grand Forks smelter.

Earthquake claim.

'The Earthquake claim lies south-east of the Golden Eagle. The geological conditions are similar, only the Earthquake lies near the eastern contact of the east dyke of porphyry. The main vein on the Earthquake is unusually well defined. It preserves its width (2 to 3 feet with "gouge" along each wall) and its dip, of 85°, to the bottom of the shaft, down 33 feet at the time of my visit. The ore, iron sulphides and chalcopyrite, has not suffered oxidation like the Golden Eagle ore. Its average value is said to be about eighteen dollars to the ton.

Pathfinder claim.

'On the Pathfinder, situated on the first ridge north of Volcanic mountain, across Pathfinder creek, a considerable amount of work has been done, and machinery, embracing pumps, a compressor and a hoist have been installed to aid in the development and testing of the property. The geological conditions are similar to those obtaining on the above mentioned Volcanic mountain prospects.

'The greenstone country-rock is cut by the prophyry dykes. Along these contacts and the neighbouring fissures, the greenstone is altered and replaced. At certain points the mineralization has taken place on an extensive scale. Vein No. 1 is about 12 feet wide on the surface, and 11 feet wide at the 50 foot level. Prophyry dyke No. 1, towards which it runs at a low angle, is only a short distance away. Vein No. 3 lies parallel to, and generally speaking along the contact of dyke No. 1. Number 2 vein lies along the opposite contact of this dyke, in the greenstone bands between dyke No. 1 and dyke No. 2. The ore bodies are apt to be irregular, due to the mode of origin, the complicated fracturing of the country-rock and subsequent faulting. The ore is largely pyrrhotite with chalcopyrite, pyrite and arsenopyrite, in a gangue of quartz, calcite and country-rock. Some melaconite

occurs in the weathered ore. The values are said to average from eleven to fifteen dollars to the ton. On the Little Bertha claim, near the river base of Pathfinder mountain, under conditions similar to those in the Pathfinder, a vein of quartz, with sulphides, etc., occurs in the gray granite. British Columbia *Cont.*

'The district known as Franklin camp, on the east branch of the North Fork, about thirty-five miles from Grand Forks, attracted a great many prospectors this season. It is reached from Grand Forks by trail up the North Fork, the natural supply route into this camp. A shorter trail for going and coming might be constructed over the divide to Arrow lake. A glance at the map will show that a feasible route from Christina lake does not exist. Broadly speaking, Franklin camp covers the area of older rocks in this east branch basin. It is locally subdivided into McKinley camp on McKinley mountain, Franklin camp proper, or McFarlane camp, on Franklin mountain, and Newby camp on Gloucester creek. Most of the available ground has now been staked, but beyond a little assessment work, the only claim having any development is the Banner, the pioneer claim of the district. On this a tunnel 194 feet long has been run, with the last thirty feet or so in ore. The ore is quartz, carrying sphalerite and chalcopyrite. In an open-cut a little to the east of the tunnel, is a large exposure of quartz, carrying some galena as well. The ore is reported to assay $18. Franklin camp.

'On the Homestake claim, a little to the west of the Banner, the country rock is silicified often in large masses. This quartz carries pyrite oxidized in places to red ochre. It is said to assay from $2 to $50. Homestake

'On the Montreal claim, near the Homestake, is a quartz vein, two feet or so wide, carrying galena, sphalerite and chalcopyrite. A greenstone breccia is the country rock. Montreal claim.

'The McKinley claim, just over the north-east face of McKinley mountain, has greenstone exposed in a stream bed for over 100 feet. This rock is altered by silicification. The quartz occurs in stringers, blebs and irregular patches. In the quartz, and also in the greenstone, are small irregular patches of chalcopyrite and pyrite. No work of any consequence has been done on this claim, and not enough of the surface is exposed to furnish much information regarding the deposit. On the Gloucester claim, on the Gloucester creek slope of Franklin, the country rock seems to be gray granite, calcified and silicified. At the bottom of a shaft, down fifteen feet at the time of visit, several feet of solid chalcopyrite and pyrite, with a little molybdenite, was exposed. This ore is said to carry $5.60 in gold and from eight to twenty per cent copper. On the G. H. claim, just east of the Glou- McKinley

British Columbia—*Cont.*

cester, also in the gray granite, is a vein of magnetite with some pyrite. The vein of almost solid magnetite, in places at least, is forty feet wide, and it has been traced for several hundred feet. It is reported to carry only traces of gold, silver and copper.

Polass and Mineral Hill claims.

'On the slope of the mountain, north of Gloucester creek, the gray granite on the Polass claim shows considerable crushing, which has developed a kugel structure, giving the rock an agglomeratic appearance. Round these balls the granitic material has flowed. In a band about ten feet wide the granite, particularly along fracture-planes, is more or less impregnated or replaced with copper- and iron-pyrites. On the Mineral Hill claim, near the western end of this mountain, the crushed gray granite carries copper-pyrites. A ledge about one foot wide contains irregular masses of this mineral, of about one-half to one inch in diameter. Since the time of my visit some work has been done, which is said to have exposed a good showing of ore.

'A good deal of prospecting has been carried on at the heads of Fire valley and the Kettle river last fall and during the present season. The townsite of Wauchope has been staked and a few buildings erected. at the mouth of Eight-mile creek, near the head of Fire valley.

Eureka claim.

'Just beyond the head of Eight-mile creek, on a branch of Barnes creek, lies a group of claims of which the Eureka is the best known. They are situated on a dyke of white rock which cuts and alters the Nisconlith rocks. In some parts of this dyke felspar crystals may be detected, but some of it is a fine-grained aphanitic quartz-like rock, which, however, weathers to some extent on the surface and effervesces with acid. The surrounding Nisconlith rocks are silicified and calcified to some extent. The dyke and neighbouring rocks are impregnated, especially along minute fractures, with small, usually silvery, metallic particles, which often weather bronzy, and with some of yellow chalcopyrite. Three different assayers are reported to have found tellurides, with high gold values, in specimens from the Eureka. But the tellurides, if they occur, are not scattered uniformly throughout the rock, as in a specimen examined in this office last winter, the metallic particles contained were found to be pyrrhotite and specular iron, and no telluride was detected. A number of specimens of the most likely looking material were selected and have been passed over to Dr. Hoffmann to be examined for tellurides.

Palladora claim.

'On Olds mountain, north of Fire valley, a little above Wauchope, is the Palladora claim. In the rather basic, altered, somewhat greenish Nelson granite, is a vein of quartz and vein matter, varying in width, but averaging about four feet, striking 85° (magnetic) and dipping about 70° N. The quartz is bluish and holds 'spiders' of pyrite, chalcopyrite, galena, and some marcasite or arsenopyrite. It is said

to assay over $30, but the average values will probably be much lower, as the amount of sulphides present varies considerably. Another parallel vein, one and one half feet wide, occurs about twenty yards north of the main vein, and a third parallel quartz vein, in places, at least, eight feet wide, occurs on the hill just north-west of the cabin. It is also mineralized, but not so heavily as the first vein. British Columbia—*Cont.*

'On the Shamrock claim, situated on Kettle river, at the base of Monashee mountain, two small parallel quartz veins have been uncovered. The quartz is heavily mineralized, especially with jamesonite, but sphalerite and pyrite also occur. Free gold occurs in the jamesonite amid the quartz, and in the cavities left by the oxidation of the sulphides, flakes of gold are quite plentiful. One specimen of the jamesonite obtained, holds a nugget of gold as large as a pea. The veins are about four inches wide. They occur in a black silicous argillite parallel to a porphyry dyke. As the claim is drift-covered and work was only starting, little can be said about the extent of mineralization upon it. A number of claims have been staked on the north side of Monashee mountain, which are said to have encouraging showings of ore. The old Monashee mine passed into new hands during the summer. Modern machinery is to be installed to give this property a fair trial. Shamrock claim. Monashee mine.

'About a mile below the new trail on the east bank of the Kettle, a prospector was doing a little placer mining. Although no mercury was being used, and all the fine gold was consequently escaping, fair wages were reported to be made. All of the drift along this part of the Kettle is said to yield colours of gold. Along the Arrow lake divide, and from Franklin camp to Fire valley, no mineralization was observed; though such might possibly occur in the gray granite area on the plateau at the head of the east branch. Placer mining.

'From what has already been said, it will appear that, for the most part, the ore deposits of the district examined this season, have a marked similarity in their mode of occurrence and origin to those of the Trail creek and other portions of West Kootenay. Of their nature and mode of formation there can be no question. They are what are sometimes known as composite veins, or shear-zone veins, formed by mineralizing solutions traversing the country-rock, principally along fissures or zones of fissures, from which they replace with their mineral contents, particle by particle, sometimes only partially, sometimes completely, the original material of the country rock. Since the deposits are found only in districts traversed by the porphyry dykes so often referred to, and usually in the rock in the immediate vicinity, if not along the actual contact of these dykes, and since the dykes are themselves to some extent mineral-bearing, it seems altogether probable that a genetic relationship exists between the dykes Mode of occurrence of ore deposits.

British Columbia—Con.

and the ore-bodies. It seems likely that the mineralizing solutions accompanied, as a later and closing phenomenon, the vulcanism which resulted in the injection of the porphyry dykes. J. F. Kemp* has suggested an igneous origin for the Trail district deposits—that these deposits were formed by the crystillization of the sulphides from the fused and cooling magma of the basic rock in which they, at Rossland, are found. But the indisputable evidences of replacement, alterations which could only be produced by heated solutions, and the fact that the same class of deposits occur in sedimentary and igneous rocks alike, are totally opposed to this theory.

'These deposits were formed just after the porphyry dykes, which, as noted above, there is good grounds for supposing to be Tertiary in age.

Ores in rocks older than Rossland granite.

'The areas where ore-bodies may be expected to occur, and hence the most favourable for prospecting, are those in which rocks older than the "Rossland" granite are cut by the porphyry dykes, and particularly such areas of older rocks as lie outside of, but somewhat adjacent to the contact of this granite. In the larger areas of older rocks included in the Rossland granite ore bodies may also occur. The smaller inclusions, though generally altered, are not heavily mineralized, since they have not afforded fissures for the mineralizing solutions, and are not large enough to have given rise to the dykes. The dykes and ore bodies extend for miles through the older rocks, from the Rossland granite areas, but it will be noted that, not many miles away from most of the camps such an area of granite is found, and it is to be remembered that areas of this granite may exist below the surface which at present have no outcroppings

'All the rocks irrespective of kind, older than the Rossland granite, are mineralized where the geological conditions have been favourable. Deposits occur in the gray granite as well as in the greenstone and sedimentary rocks. This is the case on the North Fork of the Kettle, on Olds mountain, Fire valley and elsewhere. In the Athabasca mine, Nelson, the vein has been followed during the past year from the porphyrite into the granite. Both rocks near the contact were much fractured, due to the unequal resistance of the two rocks to the stresses to which they have been subjected, and the vein as a consequence was here much broken and split up; but where followed into the solid granite it resumed its regular character, and has so far proved as valuable as when in the greenstone.

'Limestone, where it retains its bedded character, as in some parts of Burnt basin, is mineralized, but where altered and recrystallized it seems to be little mineralized, although its contact with another rock

* Ore deposits of the United States and Canada, pp. 62, 396-397.

is apt to prove a favourable point for ore deposition. The occurrence of calcite in an ore is taken to be a good local indication of gold. British Columbia Cont.

'No work need be done in the porphyry dykes themselves, in the expectation of striking a large body of sulphides. While most of these dykes have a slight tenor, and might at certain points contain enough to be of value, no large ore-bodies similar to those in the adjacent rocks, occur in them. The areas of Rossland granite also seem to be barren, that is to say, no deposits similar to those now known to occur in the older rocks, have been found or are to be expected in this granite. Some minerals of economic value may, of course, eventually be found in them, but if so they will, at least in their mode of occurrence, be dissimilar to the deposits now being sought for and worked. Porphyry dykes unpro-

'The Grand Forks smelter, built and operated by the Granby Consolidated Mining and Smelting Company, was completed and blown in toward the close of the season. At first only one furnace was used, but now both are in operation, with a joint capacity of 600 tons per day. The ore is obtained from the Victoria, owned and operated by the Smelter Company, the Old Ironsides, Knob Hill and City of Paris mines, as regular shippers, with occasional lots from the Winnipeg, Athelston, Humming Bird and Golden Eagle. Other custom work is done when offered. The smelter management state that they are prepared to enlarge the capacity of the plant as need may require. The treatment of the low-grade Boundary ores have so far proved more successful than was anticipated. The ores have proved self fluxing. Should any flux be required, it may be conveniently obtained from the immediate neighbourhood. Very little roasting has been resorted to, only small job lots, about one-twentieth of the total ore treated, have so far been roasted. Consequently very low smelter rates can be offered. These low rates for treatment will have a stimulating effect upon the Boundary district, where the immense ore-bodies are of low grade, and until the smelting possibilities had been proved, their success remained somewhat in doubt. The British Columbia Copper Company's smelter at Greenwood is nearing completion, and a plant is also being erected by the Standard Pyritic Smelting Company, near Boundary Falls. Grand Forks smelter. Smelters under construction.

'On the whole, mining has continued to make substantial progress throughout West Kootenay during the past year. The mines of the Slocan, which were closed down last year on account of labour troubles, were re-opened early in the year. Almost all the old mines are shipping as usual, and the tonnage of this year will greatly exceed that of last. It should almost equal that of 1898. The Ivanhoe concentrator is almost completed, and when this is running a large addition will be made to the Slocan output. The Slocan lake properties are de- Progress of mining in West Kootenay.

British Columbia *Cont.*

veloping favourably. The output for the year, principally from the Arlington, Bosun and Enterprise mines should approximate 5,000 tons.

Nelson district.

'In the Nelson district, the closing down of the Fern mine and the Hall mines and smelter, has somewhat offset the progress made in other parts of the district. The smelter, under new control, is now in operation again, with sufficient custom work to keep it running steadily, and on the Silver King mine, under a new and separate management, work has again been resumed. The Ymir mine has made the most marked progress; it is now treating 200 tons a day, with an 80-stamp mill. Some properties, as the Athabasca, Granite and Yellowstone, are producing steadily, and others are making occasional shipments, so that the output of the district will show no falling off.

Rossland district.

The Rossland district is steadily increasing its output. Last year showed a marked increase in production over all preceding years. This year, despite the stoppage of shipments from the War Eagle, and the limited capacity of the smelters, the tonnage should be about one-fifth greater than that of 1899. The weekly output is now over 6,000 tons; recently a shipment of 7,000 tons was made. The values here, as in many of the districts, show a tendency to decline. This may be partly accounted for by the quantity of second grade ore which is now being shipped. The Le Roi is now stoping its vein for a width of 105 feet. The Centre Star is now shipping heavily. The Le Roi No. 2, (Josie) is also shipping, and Le Roi No. 3, (Nickel Plate) will soon commence. Altogether about eleven properties have been shipping, and several others are preparing to enter the list.

Molybdenite ore.

'At the Giant mine, which is making a small daily shipment, a fine grained molybdenite occurs in considerable quantity through the ore. It is scattered through it in particles varying from almost microscopic dimensions to masses a foot in diameter. It has a valuable gold tenor and is shipped with the rest of the ore to the smelter.

Beaverton camp.

'There was considerable activity on the west fork of the Kettle river, when visited in the spring. Thirty miles from a wagon road, over a bad trail, the town of Beaverton was being built. Time did not permit an examination of the camp, but some good showings of ore were seen. The camp furnishes fine ore specimens, particularly of copper sulphides and native silver.'

Work by Mr. J. McEvoy.

Mr. J. McEvoy, during the early part of the year 1900, was engaged in working up the notes of his previous year's exploration in East Kootenay. Early in the summer he commenced a geological examination of the Crows Nest Pass coal-fields, the principal object being to determine the extent and relations of the coal deposits in that area with

greater accuracy than had heretofore been done. Mr. McEvoy reports progress as follows :— British Columbia—*Cont.*

'I left Ottawa on May 9 and returned on October 9. Mr. J. Keele accompanied me during the season and assisted materially in the work.

'The Crows Nest coal-field is situated immediately west of the summit of the Rocky mountains on the Crows Nest pass. It is all included in the province of British Columbia, excepting a small portion in the immediate vicinity of the pass, which crosses the watershed into the district of Alberta. The area of Cretaceous rocks in the vicinity is nearly 500 square miles in extent. The coal measures, originally deposited over the whole of the area, have been eroded away around the edges, where the rocks are crumpled and folded, and along some of the deeper valleys penetrating well into the area, so that their actual area is approximately 230 square miles. In shape, the area covered by the coal measures, like that of the Cretaceous basin itself, is, roughly speaking, a long pointed triangle, with its base to the south. Its greatest length is about thirty-five miles, north and south, and its greatest width about thirteen miles. These figures are of course only approximate as the work has not yet been plotted. Crows Nest Pass coal-field.

'Coal is said to have been discovered in this part of the country many years ago. Its reported existence is alluded to in the Report of Progress of the Geological Survey for 1880–82 (p. 2 B). It is again referred to in the report for 1882–84 (p. 111 C). The coal-bearing area was approximately defined and examined in a preliminary way by Dr. G. M. Dawson in 1883. It was again visited after some prospecting had been done, by Dr. A. R. C. Selwyn in 1891.*

'The Crows Nest branch of the Canadian Pacific Railway, descending Michel creek on the western slope of the mountains, crosses the northern part of the coal lands. It then follows the Elk river downward nearly along the line of the western boundary of the Cretaceous area, for a distance of about twenty-five miles. The upturned western edge of the Cretaceous rocks form a ridge or escarpment which runs parallel to the Elk river and three or four miles distant therefrom. The height of the escarpment is fairly uniform, being 3,500 to 4,000 feet above the river. About half-way up the slope the coal measures are found outcropping with dips of 30° to 40° eastward. Proximity of coal area to railway.

'A search for fossils in the limestones underlying the Cretaceous rocks, resulted in the discovery of several specimens of the genus *Productus*. These rocks have been classed as Devono-Carboniferous, and for the greater part of their extent such classification must Carboniferous rocks.

*See Annual Report, Geol. Surv. Can., (N. S.), Vol. I. (1885), Part B., and Summary Report, 1891.

British Columbia—Cont.

remain. The discovery of *Productus* is, however, fairly good evidence that in this part the upper members of the limestone series is definitely Carboniferous.

'Notwithstanding the great lapse of time between the Carboniferous and Cretaceous deposits, wherever their relation to each other could be seen they appear to be conformable. The general attitude of the Cretaceous rocks is that of a wide flat-bottomed syncline, or rather basin, for the beds are upturned at the north and south ends of the area, as well as at each side. On the south and west borders of the area, the upturning has been accomplished without much faulting of the coal measures and overlying beds, but the lower members of the series, consisting of the black shales and soft calcareous shales, have been badly crushed and folded. It is along or near the eastern edge of the area that the greatest dislocation has taken place. The greatest erosion, however, did not here follow the line of contact with the limestones, but is marked by a depression in the hills, running parallel to the contact, and about four miles inside the border. In some places here at the actual contact, the Cretaceous measures appear to have been tilted up bodily, without crushing, and it may be hoped that further work will discover a section where the thickness of the lower beds of the series may be obtained. Such a section could not be found on the western edge, on account of the crushed and folded state of the rocks previously mentioned.

General attitude.

'Although in general the Cretaceous rocks are said to have assumed the form of a flat-bottomed basin, there are many places where local faults have destroyed the symmetry of this arrangement. Some of these faults are of considerable dimensions and will form an important factor to be reckoned with in the problem of systematically mining the coal.

Measured section on Elk river escarpment.

'Before attempting any detailed statement of the situation of the coal measures it is perhaps desirable to have an idea of the character and thickness of the Cretaceous rocks occurring in the basin. Toward the end of the season, a section was measured on the front of the escarpment, about three miles north of Morrissey siding. A steel tape was used and slopes were measured with a hand-level. The results should be fairly reliable. It is only in the adjustment necessary where there was a local twisting of the beds, that there is room for any appreciable error. The site selected for the section was on a small spur from the escarpment, where, some years ago, Mr. Fernie had excavations made on the outcrop of the coal seams. The crest of the spur has an average slope of nearly thirty degrees, and affords the exceptional opportunity of getting an unbroken section of almost 5,000 feet. Dr. Selwyn, then Director of the Survey, published in the Summary Report for 1891 a list of the seams then measured. The

section which follows is given in the natural order, beginning at the top of the escarpment and running downward.

British Columbia—*Cont.*

Section on Elk River.

		Feet	Inches
1	Hard conglomerate	6	0
2	Gray nodular limestone in soft brown shale	3	0
3	Hard, coarse conglomerate with layers of sandstone	38	0
4	Brown shale and brown soft nodular sandstone	48	0
5	Hard conglomerate with layers of gritty sandstone	50	0
6	Covered	33	0
7	Gritty sandstone	16	0
8	Brown shale	35	0
9	Gritty sandstone and conglomerate	13	0
10	Bluish, thinly bedded sandstone	41	0
11	Brownish, shaly sandstone	30	0
12	Black shale	14	0
13	Gritty sandstone	22	0
14	Black shale	11	0
15	Conglomerate and gritty sandstone	25	0
16	Black shale	4	0
17	*Coal*	2	6
18	Black shale	20	0
19	Conglomerate	85	0
20	Black and brown shale with one layer carbonaceous shale	72	0
21	Hard gray sandstone	11	0
22	Conglomerate	20	0
23	Hard gray sandstone	65	0
24	Carbonaceous shale. (Some coal?)	8	0
25	Black shale	6	0
26	Brownish shale	27	0
27	Fine-grained gray sandstone	24	0
28	Brownish shale; some beds of soft sandstone	84	0
29	Bluish hard sandstone	10	0
30	Black shale	8	0
31	*Coal*	2	0
32	Brown and black shale	57	0
33	Gray sandstone	96	0
34	Black and gray shale	34	0
35	*Coal*	1	0
36	Brown shale	3	0
37	*Coal*	1	0
38	Thinly-bedded bluish sandstone	14	0
39	Hard gray sandstone	133	0
40	*Coal*, including some carbonaceous shale	5	0
41	Black and brown shale	20	0
42	Hard gray sandstone with three irregular layers of conglomerate	175	0
43	Black shale	27	0
44	Coal (upper foot impure)	4	0
45	Black shale	38	0
46	Hard gray sandstone	55	0
47	Deeply covered	100	0
48	Shale, probably including some coal	107	0
49	Carbonaceous shale	8	0
50	*Coal*	7	0
51	Carbonaceous shale and coal	2	0
52	Black shale and carbonaceous shale	33	0
53	*Coal* (impure)	3	

British Columbia Coal.

		Feet.	Inches.
54	Shale and soft sandstone	6	0
55	*Coal*	5	0
56	Carbonaceous shale	4	0
57	Black shale, including some carbonaceous shale and possibly some coal	150	0
58	*Coal*	3	0
59	Black shale and carbonaceous shale	100	0
60	Carbonaceous shale and coal	20	0
61	*Coal*	10	0
62	Black and brown shale and carbonaceous shale with thin seams of coal	140	0
63	*Coal* (upper ten feet impure)	36	0
64	Brown and black shale	134	0
65	Hard sandstone	56	0
66	Black shale	4	0
67	*Coal*	1	4
68	Shale	0	5
69	Coal	0	9
70	Shale	0	10
71	*Coal*	6	0
72	Shale and shaly sandstone	208	0
73	*Coal* (upper foot impure)	2	6
74	Bluish shaly sandstone	2	0
75	*Coal*	2	6
76	Black shale	65	0
77	*Coal*	4	0
78	Shale	1	7
79	*Coal*	4	9
80	Shale	6	0
81	*Coal* (bottom two feet impure)	19	0
82	Bluish black shale	10	0
83	" sandstone	35	0
84	Black shale	125	0
85	*Coal*	2	6
86	Chiefly black shale, partly covered	364	0
87	*Coal*	1	4
88	Shale	1	3
89	*Coal*	46	0
90	Black shale	16	0
91	Hard gray sandstone	60	0
92	Black shale	110	0
93	*Coal*	46	0
94	Black shale	10	0
95	Hard gray sandstone	100	0
96	Black and brownish shale	1,060	0
	Total	4,736	3
	Total thickness of coal	216	2

Thickness of workable coal.

Of the above thickness of coal, the greater part, 198 feet, occurs in a thickness of measures of 1,847 feet. Besides the parts of the coal mentioned in the section as impure, there are some irregular layers of shaly material and nodular iron-stone in the larger seams. Making allowance for these, and deducting some of the smaller seams that could not be profitably mined, say three feet or under, it may be safely

concluded that there is a total thickness of workable coal of at least 100 feet. British Columbia—*Cont.*

Disturbed rocks at bottom of series.

'Below the base of the section the rocks are disturbed and broken, but the black shales last mentioned appear to continue for some distance farther. These are succeeded by 500 feet or more of soft gray sandy argillites, fairly calcareous and occurring in thick beds. Below the argillites comes an uncertain thickness, possibly 1,000 feet, of thin shaly limestone and calcareous shales. Although not seen in this place, a band of rather coarse grained fragmental limestone belongs to this horizon. The lowest beds of the series are not exposed here, but where seen elsewhere, consist of black shales with two or more layers of hard fine-grained dark-coloured dolomitic limestone. Their thickness has not yet been ascertained, but they appear to be several hundred feet at least.

Preservation of coal seams by harder beds above.

'Toward the top of the section, it will be noted that the beds largely consist of conglomerate and gritty sandstone. The conglomerate especially is very hard. Its pebbles are principally of black and gray chert, imbedded in a matrix so silicified that cleavage-planes cut both pebbles and matrix as if the rock were of homogeneous texture. The preservation of the coal measures is in a great degree due to the presence of these hard beds, which prevented erosion, and by their great strength saved the more yielding beds of the underlying coal measures from crushing and folding. The conglomerates and sandstones are false-bedded and of irregular thickness, and individual beds cannot be expected to be continuous over very large areas. The beds consisting chiefly of nodular limestone, near the top of the section, and another similar bed occurring a few feet higher up in the series, have been recognized in several places in the same relative position to the conglomerates, and may be regarded as a definite horizon for the correlation of the strata at widely separated points.

Rocks of series above the measured section.

'Above the top of the measured section, the overlying rocks are seen northward along the escarpment, the first succeeding bed being ten feet of soft brown shale, then the second band of nodular limestone in brown shale already mentioned, followed by 200 feet or more of alternating layers of brown shale and sandstone, in beds of six to fifty feet thickness. Above this, although partial sections were obtained here and there, the continuity is broken. There appears to be altogether a development of 4,000 to 5,000 feet of measures above the top of the section just given. In contrast to the lower part of the series, black shales are rarely found here. Brown colours prevail throughout. The principal rocks are: soft brown friable shale decomposing easily into brown sand, brown shale weathering into angular blocks, soft gray, greenish, and yellowish sandstone weathering brown and reddish, frequently unequally and nodularly hardened. There are

British Columbia—Coal

some beds of harder gray sandstone and conglomerate. Dark gray friable shale forms an appreciable part of the series, and an occasional band of black shale is to be seen. Toward the top of the series there is a notable bed of conglomerate, composed of well-rounded dark, cherty quartzite pebbles up to six inches in diameter, loosely held together by a matrix of soft gray sandstone. It decomposes readily, the pebbles being found in abundance in stream-beds and strewn along the hill-sides, while the rock in place, like the outcrop of coal-seams, is only to be found in certain favourable locations.

Total thickness of series.

'The total thickness of Cretaceous rocks deposited in the area, according to the above estimates, is from 12,000 to 13,000 feet..

'It is not at all probable that a section could be found in any other part of the area that would exactly, or even closely, correspond to the one just given. A comparison of a part of this section with the beds at the mines on Coal Creek, shows that there is a great difference in thickness between the measures at the two places. The coal seams numbered 61, 63, and 71, in the section, correspond to the three seams which up to the present have been chiefly worked at the mines as shown in the following table. The distance between the two places is about seven miles.

Correlation with Coal creek.

	Near Morrissey.	On Coal Creek.
Coal	10 feet.	10 feet.
Intervening beds	140 "	60 "
Coal	36 "	30 "
Intervening beds	197 "	42 "
Coal	6 "	6 "

'It will be seen that while there is a great diminution of the intervening beds, the coal seams are fairly persistent. This may not be the case throughout the whole of the area, but whatever change may take place, is as likely to be favourable as othewise. The openings at Michel, sixteen miles north of the mines on Coal creek, expose three seams of coal, fifteen to seventeen feet in thickness, but there is not yet sufficient evidence to correlate them with the seams at Coal Creek. What there is, however, tends to show that some of the seams at least have a greater thickness here than they have to the south.

Continuity of seams.

Beds at Marten creek.

'The coal seams near Marten creek were not examined in detail, as the excavations made there, about the same time as those near Morrissey, have caved in, and re-excavation would be necessary to expose the seams. Measurements were made at this place also by Mr. Frank B. Smith, engineer for the Crow's Nest Pass Coal Co., and the results are given in Dr. A. R. C. Selwyn's Summary Report for 1891. A part of this list of seams agrees fairly well with the Morrissey section, but in other parts there is a marked difference. It

appears likely that the four lowest seams there given, are a repetition of some of the upper ones, and are placed at the bottom, either by attempting to compile partial sections at two or more places, or because the excavations were continued downward across a line of fault which runs north-and-south, near the outcrop of the lower seams. The lowest of the large seams was not fully exposed when the list was published, and further work showed a much greater thickness of coal than was then estimated. Apart altogether from any success in correlating the individual seams in this section at Marten creek with those in the Morrissey section, there is abundant evidence to show that they are of the same horizon, and that there is only one set of coal measures to be found in the area. British Columbia—*Cont.* One set of coal measures.

'The Kootanie series of Dr. Dawson comprises the lower and middle beds of the section just given. Their age has been established as Lower Cretaceous, chiefly by the determination by Sir J. William Dawson of fossil plants contained in the beds of the coal-bearing horizon. It was remarked in this connection that the list of plants included "some forms usually regarded as Jurassic, but that the greater number have the facies of the Lower Cretaceous."* There is, however, in this section at least 3,000 feet, and probably a much greater thickness, of beds underlying the horizon from which these plants were taken. This year two specimens of Ammonites and several specimens of a Belemnite were discovered in these lower beds. They have not yet been determined, however. The rocks of the upper part of the section probably extend into the upper division of the Cretaceous representing the Dakota group or even higher members. No fossils have yet been found in these beds. Age of coal-bearing rocks.

'Without the assistance of a map, the work not yet being compiled, it is difficult to give a clearly intelligible description of the outcrop and attitude of the coal seams, but by omitting detailed statements of distances and elevations, something further may be said. Along the front of the escarpment facing the Elk river, the coal seams begin to outcrop at elevations of 1,500 to 2,000 feet above the river. The dips are uniformly to the east at angles of 20° to 40°. Going eastward up Coal creek, these dips are seen to flatten out, until at a distance of about five miles from the Elk the beds are almost horizontal. They continue thus with slight undulations nearly to the summit between Coal creek and Marten creek, where the dips begin to be reversed. A short distance beyond, to the north-east of the summit, these dips are greatly increased and the successive beds are rapidly brought to the surface till the coal measures again appear at the crossing of Marten creek. Attitude of beds. Elk river. Coal creek

* Trans. Royal Soc. Canada, vol. X., sec. IV.

British Columbia Coal.

'Marten creek is one of the sources of the south branch of Michel creek, which occupies a wide low valley running northward to the "loop" on the railway. The erosion of this valley has carried away the coal measures from a wide strip of country. The valley follows the

Marten creek.

line of what was, at one time, probably a broken anticline caused by the uplifting of the limestone floor of the basin. Two faults resulting from this movement are to be seen running parallel to the valley, one on each side. The uplift was greatest to the north where there is a protruding hummock of the limestone near the junction of the west branch. Toward the south, evidence of this movement gradually dies out, extending only a few miles to the south-east of the mouth of Marten creek.

East of Michel creek.

'Beyond the valley of the south branch of Michel creek, the coal measures outcrop well up the mountain side in the same attitude and relative position to the stream that the beds on the front of the escarpment bear to the Elk river. The measures continue eastward forming another syncline, narrower than that first described, on the west side of the valley, and should outcrop again on the mountains near the edge of the Cretaceous area. Further information is, however, wanting at this point.

Faulting of beds north of Coal creek.

'North of Coal creek, in the area lying between the south branch of Michel creek and the Elk river, the beds do not long continue to hold the same regular form that they exhibit along Coal creek itself. A few miles north of the creek, the transition from the steep dips at the front to the horizontal position farther back is more abrupt; and, a short distance farther northward, becomes a sharp break with more or less faulting. This fault continues northward to opposite a point between Hosmer and Sparwood stations. Beyond that the beds resume a more normal attitude, such as they have near Coal creek. On the east side of the fault the rocks dip to the south at angles of 10° to 15°. The result of this is that the coal measures are brought nearer to the surface, and they are found outcropping on the side of a deep gash in the hills made by a small stream emptying into the south branch of Michel creek, below the junction of the east fork. This stream thus causes another bay in the outline, at least of the upper part, of the coal measures. Eastward from this place, the beds bend around gradually to join the measures at Marten creek, without any further serious dislocation. The fault above mentioned generally lies behind the front of the escarpment, but for a few miles northward from a point opposite Hosmer it cuts across the face of the hills some distance below the summit. This gives a complicated appearance which is the only exception to uniformity along the entire front.

'Where Michel creek cuts through the northern part of the area, the basin is narrow, and the upper part of the coal measures has been eroded away in the valley.' 'The bottom of the syncline is probably a short distance to the east of Michel station, and it appears to rise gradually both to the north and the south, with the lowest point of the basin, or trough, situated a little to the south of the stream. British Columbia—*Cont.* Attitude of beds near Michel.

'There are minor folds and irregularities in the rocks, and even with the help of the knowledge gained by the Coal Company in its operations at this place the situation is not entirely clear.

'To the north of the stream the beds continue in the form of a gradually rising syncline for a distance of about six miles. Beyond this, although Cretaceous rocks occupy the bottom of the Elk River valley for some distance, there is no sign of any coal measures for fully twenty-five miles. For several miles of this length the Cretaceous rocks are altogether wanting and the Carboniferous limestones and quartzites are exposed to view. North of Michel creek.

On the hills to the east of the 'loop' on the railway at the forks of Michel creek, thin remnants of the Cretaceous rocks are left in patches, and parts of the two lowest coal seams still remain, but for the most part the measures have been worn away.

'The narrower syncline of coal measures on the east side of the south branch of Michel creek, continues northward beyond the interruption caused by the east branch and extends for a short distance across the main watershed into the district of Alberta. The coal measures in this extension occur in a long spur from a mountain, four or five miles southward from the Crows Nest summit on the railway. They are fairly flat-lying for the greater part, but on the west side of the spur, facing the old pack trail, a sharp fold or fault has given the rocks a dip of 60° to 70° to the north-east. Hereabouts, especially on the coal seams occurring in the steeply-dipping part of the rocks, the British American Coal Company has done a good deal of prospecting. The seams have been exposed at the surface in many places, and during the last season a tunnel was commenced with the object of tapping the seams some distance below their outcrop. The point at which the tunnel is driven is 600 feet up the hill, but the seams are exposed lower down, and can no doubt be found near the base of the hill in a convenient place for shipping the coal. Continuation into Alberta. British American Coal Company

'In the part of the coal lands thus far described, there is no very great area intact, and as there are several points from which the measures may be conveniently attacked, no excessive underground haulage will be necessary. The coal seams do not reach any great depth, being almost entirely above the level of the Elk River.

British Columbia Coal

'The measures lying south of Coal creek occupy a practically unbroken block of country twelve miles or more in width and of somewhat greater length. Along the front by the Elk river, the beds continue to hold uniform easterly dips and behave in the same way

Area south of Coal creek.

that they do at Coal creek. Morrissey creek, ten miles south of Coal creek, makes a slight indentation in their outline and affords a good site for mining operations. Southward from Morrissey creek, the escarpment or rim of the basin begins to bend to the east and continues curving around along the southern limit of the measures by Lodge-pole creek, finally turning northward as far as the Flathead river at the south-eastern corner of the area. Here the escarpment ends. The rocks all the way around dip regularly inward. They gradually flatten out to a more or less horizontal position a few miles from the edge, without any noticeable fractures, but in so doing, in this southern part of the area, they are carried to a greater depth than they are to the north. A section eastward from Morrissey creek would show that the coal measures, after first bending to a horizontal position, rise a little in a gently swelling anticline and then slope steadily downward till they reach the lowest depth in the whole area. This point of greatest depth is only three or four miles from the eastern edge of the basin. The rocks at the surface are the highest beds of the section previously given and they still dip to the east. A low drift-covered valley lies between this point and the eastern edge, where the lowest beds of the series are upturned against the limestone mountains. It is probable

Accessibility of seams.

that this rapid transition has been assisted by faulting. Owing to the depth of the measures in this eastern interior part, it is doubtful whether the coal can be profitably extracted. For the greater part, however, the conditions for mining are favourable enough. Coal creek, Morrisey creek and Lodge-pole creek are all suitable places to commence operations, and a part of the area can be reached from the south branch of Michel creek.

Crow's Nest Pass Coal company.

'The mines of the Crow's Nest Pass Coal Company at Coal creek, already referred to, were started when the Crow's Nest branch of the Canadian Pacific Railway was built. On this line, near the crossing of Coal creek, the town of Fernie has sprung up. It is a good example of rapid western growth. The mines are reached from Fernie by a spur from the main line running four and a-half miles up the creek. The good quality of the coal is now so well established that further mention in that respect is unnecessary. The output is increasing

Coke ovens at Fernie.

rapidly of late and is now well over 1,000 tons a day. About one-half of this is converted into coke, 360 bee-hive ovens being in constant operation at Fernie. The coke produced is of superior quality and preparations are being made to increase the number of ovens.

'In addition the mining on Coal creek the company has recently commenced work on the seams at Michel and is already turning out coal for shipment. Material is on the ground for the construction of coke ovens and this point promises shortly to equal Fernie in importance. British Columbia—Mining at Michel.

'Although the extent of the coal lands in the area can as yet be only somewhat roughly estimated, the estimate (230 square miles) should be near enough to the truth to be used as an argument for the calculation of the total available coal supply. The thickness used in the calculation is the minimum already given of 100 feet of workable coal. Estimate of total workable coal.

Total area of coal lands.....		230 square miles.
		= 147,200 acres.
One acre with 100 feet of coal would yield...	153,480	tons of 2,240 lbs.
50,000 acres would yield	7,674,000,000	" "
147,200 acres would yield	22,595,200,000	" "

Mackenzie District.

As explained in the Summary Report for 1899, Mr. J. M. Bell remained, in the autumn of that year, at Great Slave lake, wintering there with the object of continuing explorations in the far northern region in the summer of 1900. It was decided to authorize Mr. Bell to undertake an examination and survey of the shores of Great Bear lake, and instructions to this effect were sent in by the Hudson's Bay Company's winter packet. Mr. Bell has succeeded in carrying out the work outlined with ability and success; the only unfortunate circumstance connected with it being the desertion or loss of one of the men comprising his party, under circumstances of which he was unable to obtain any satisfactory explanation, although diligent search was made for the missing man. Mr. Bell reports as follows upon the work :— Work by Mr. J. M. Bell.

'In June, 1899, I left Ottawa in company with Dr. Robt. Bell, for Great Slave lake, to act as his assistant in explorations to be carried on in that part of the country. As has already been related in Dr. Bell's summary report for 1899, I passed the summer making a topographical and geological exploration of the Fort Rae arm of Great Slave Slave lake, together with its north-western expansion, Lake Marian, and in the autumn worked along the south-eastern and northern shores of Great Slave lake. Dr. Bell having found it advisable, according to your instructions, to leave me in the north, to continue operations during the autumn and winter and to carry on further work during the summer of 1900, arrangements were made with Mr. F. C. Gaudet, of the Hudson's Bay Company, at Fort Resolution, by which I was to Winter at Fort Resolution.

Mackenzie district—*Cont.*

pass the winter with him. During the winter I made several short excursions east and west of the Slave river and made an examination of the limestone rocks exposed in that part of the country. I also kept the readings of the barometer and thermometer at Fort Resolution and obtained much useful information, by inquiries from the Indians, regarding the country east and north of Great Slave lake.

Exploration of country between Great Slave and Great Bear lakes.

'Late in March, I received your instructions to make an exploration of the country between Great Slave and Great Bear lakes, together with as much as possible of the shores of the latter, and therefore, immediately set about making preparations for the long trip to the northward. I obtained the services of two men at Fort Resolution, as from what I was informed, it seemed likely that any men engaged farther on, would be anxious to come as far south as this Post on my return journey. Having made inquiries from all reliable sources regarding the various routes to Great Bear lake, I decided that the best route thither was by the Mackenzie and Bear rivers, returning overland from Great Bear lake either by Lac la Martre, or Lac Ste. Croix, the former of which was said to be the easer of the two. By taking the route via the Mackenzie, it was supposed that owing to the early opening of navigation of that river, Great Bear lake could be reached much earlier than by going via Lac la Martre. Furthermore, no supplies whatever, could be obtained at Fort Rae, while there was a chance of getting a fair outfit at Fort Simpson. Accordingly I left Fort Resolution on April 11, with Charles Bunn and Louis Tremblay, the two canoemen mentioned above, and one dog-team, carrying my canoe and dunnage, which was to go with us across Great Slave lake to Fort Providence. Another load with instruments, supplies, etc., had preceded us, and we met the men and dogs returning in making our traverse of the lake. The travelling on the lake was exceedingly bad, a thaw having set in which covered the ice with water, so that we could travel only at night and then with difficulty. The trip to Hay river that I had made during the winter in two days, now took us five to make, and we did not reach Fort Providence until the 23rd. I delayed there until the 28th, taking astronomical observations, to compare with those previously taken there by other observers. From Fort Providence we went to the mouth of Willow river, some sixteen miles below, where the employees of the Hudson's Bay Company's steamer *Wrigley* were working, and with them I stayed till the Mackenzie opened. I chose this halting place on account of the abundance of wild fowl and fish which could be obtained there. I was advised to go as far as Fort Simpson at least, by steamboat, on account of the difficulty of getting a landing-place, owing to the ice being piled high along the shore at this time of the year.

Date of leaving Fort Resolution.

Wait at Willow river for the Mackenzie to open.

'The ice of the Willow river broke up on the 6th of May, and the Mackenzie on the 12th, but the *Wrigley* was unable to leave before the 21st, so I passed the intervening time in making a short exploration up the Willow river. This stream is interesting as being the route followed by the Slave Indians to Mount à la Corne and Lac la Martre. Some seven miles up we encountered small rapids which are said to continue as far as Willow lake, a distance of about thirty-five miles. The *Wrigley* reached Fort Simpson on the 21st of May, and I delayed here for a week to arrange about supplies, and managed to obtain a small but sufficient quantity. We set out from Fort Simpson in our own canoe, and by travelling all night with the swift current of the Mackenzie, reached Fort Wrigley in a day and a half. Below this post I delayed for two days to make a short trip into the interior at Rocher Trompe à l'eau, so that it was the 3rd of June before we sighted Fort Norman. Here we had a long wait. The Bear river had broken only two days before our arrival, and Indians who arrived soon after the ice had gone out of the river told us that tracking on the Bear river would be impossible for at least two weeks, owing to the ice piled high along the shore, and that Great Bear lake itself was still as solid as in midwinter, so I again occupied myself by making trips into the interior and by rearranging my plans and outfit for our trip. Here I hired two extra canoemen, Charles Camsell and John Saunderson. Saunderson agreed to act as guide and interpreter around Great Bear lake. He had a good wooden canoe which he was to give me the use of during the season.

Mackenzie district—*Cont.*

Exploration of Willow river.

Leave Fort Simpson for Fort Norman.

'The party left Fort Norman on the 18th of June, being composed of myself and the four canoemen already mentioned. The trip up the Bear river was accomplished in six days. The news that Indians were still crossing the lake with dog teams was anything but encouraging intelligence to greet our arrival, and we were obliged to wait till the 4th of July before we could leave the head of the Bear river. While there we made arrangements with the Indians to meet us in McTavish bay and to furnish us with a guide who knew the lake and portage route to Fort Rae.

Fort Norman to head of Bear river.

'Leaving the embouchure, we turned to the left and followed the north-western shore of the lake. We had numerous delays from the ice, it being often necessary to portage our load over the points, and we did not reach Richardson bay till the 12th. Here I thought it better to follow an old portage route from the foot of the bay across Gros Cap to Smith bay, thus hoping to escape the ice which was still unmoved around the Gros Cap, as well as to look into the geology of the interior. Reaching Ice-bound bay, a portion of Smith bay, we were again delayed by the ice, so that it was the evening of the 24th of July, and then only by breaking our way through the ice for four

Delayed by ice.

Mackenzie district—*Cont.*

miles, that we were able to get off and make the traverse for the north shore.

Traverse made to Coppermine river.

'The time was, however, not lost, and the country was well examined. Following the north shore we reached the north-eastern extremity of the lake, the site of old Fort Confidence, on the last day of July, and thence made a traverse to the Coppermine river. We left Fort Confidence on our return journey on the 13th of August, but did not reach the rendezvous agreed upon with the Indians till the 29th, the coast-line being much longer than expected. The Indians had already gone and so we were obliged to start across country without a guide. My party was now reduced to three voyageurs and myself, Bunn having left us on the Barren Lands. It was now too late in the year to attempt to go farther around the lake and take the portage route via Lac la Martre, so we decided to try the other way by Lac Ste. Croix, which was said to be shorter, though more difficult. We were now entirely out of provisions, except such as we could obtain by hunting or fishing.

Great Bear lake to Fort Rae.

'The trip from Great Bear lake to Fort Rae was not an easy one, and we often had great difficulty in getting along. The route followed lay almost entirely through new ground, so that the names on the map showing the route will be for the most part unfamiliar. Leaving Great Bear lake we ascended a river about seventy-five yards in width at its mouth, which I have called Camsell river, and passed on through its expansions Lacs Clut and Grouard. From the latter we made a portage into a large lake, known to the Indians as Hottah lake. This lake is nearly fifty miles in length, and lies almost north-and-south. Its waters flow into MacVicar bay of Great Bear lake. From the southern extremity we portaged into Lake Stairs and were again in the waters of the Camsell river. Thence we followed the river or its expansions as far as the height of land, making numerous portages to avoid rapids, and often searching for a long time to find our way onwards. At Lake Rosamond, a beautiful clear stretch of water, the second large lake before we reached the height of land, we were lucky enough to encounter some Fort Rae Indians, and from this lake our course was an easy one. I engaged three of them to come to the Post with us to help us over the height of land portages and to guide us quickly southwards.

Portage to Hottah lake.

Engage Fort Rae Indians as guides.

'Leaving Lake Rosamond, there was again a stretch of river filled with rapids, avoided by three portages with small lakes between, which brought us into Lake Dawso-necha, which was about twenty-five miles in length. At its southern end we again entered the river, and after going some six or seven miles came into a small lake, from which we made several portages in crossing the height of land and entered the

Follow Marian river to Lake Marian.

head-waters of the Marian river. This we followed to its junction with the Petitot river, from Lac la Martre, and continued our way down the united stream to Lake Marian, which we reached on the 18th of September and got to Fort Rae on the 20th. We crossed Great Slave Lake among the islands, although it was considered rather late to attempt the crossing, and reached Fort Resolution on the 29th of September. Thence we continued our way up the Slave river to Fort Chipewyan, where we thought it best to wait till the river froze over. We were not able to leave Fort Chipewyan before the 14th of November. I left the fort with two dog-teams and two dog-drivers, having only Charles Camsell still remaining with me of my original party. I reached Edmonton on the 7th of December and Ottawa on the 12th.

Mackenzie District *Cont.*

Crossed Great Slave lake.

Date of reaching Edmonton

'The method of survey during the summer varied according to circumstances. In the larger lakes, on the return route, and in Great Bear lake, bearings were taken with a prismatic compass. As a rule distances were measured by the speed of the canoe paddled at a regular rate in calm water, but frequently, especially around Great Bear lake, a system of rough triangulation was caried out, after having found an initial base on which subsequent triangles were built. On all the land traverses, including the long one to the Coppermine river, distances were measured by pacing. Hills were often ascended to sketch in the contour of the shore and to take long bearings. This was especially useful for lakes on the Barren Lands. Observations were taken nearly every clear day for latitude and frequently for magnetic variation. An accurate record of the weather and the readings of the thermometer for both air and water and of the barometer were kept. A number of photographs were also taken.

Method of surveys made.

Distances measured by pacing.

Record of weather kept.

'The Bear river is a fine large clear-water stream about eighty miles in length, with an average width of one hundred and fifty yards and an average current of nearly five mile per hour. It is easily navigable throughout its entire course, with one exception, namely at the rapid, where a rocky range crosses the river. Great Bear lake is roughly stellate in shape, having five huge rays or arms. Its greatest length from the head of the Bear river to the mouth of the Dease, does not greatly exceed 160 miles and its width from Cape Etta-d'ettellé to Gros Cap is approximately 55 miles, but the immense arms stretching in five different directions, greatly increase its size and give it a shore-line many hundreds of miles in length. On wide traverses I several times made soundings. Crossing Smith bay in one place, I found the depth to be 116 feet, and in another, 281 feet of cord did not find the bottom, although not two miles farther west, my other canoe-men found the botton at twenty feet. The topography of the lake varies with the country-rock. The south-

Bear river.

Description of Bear lake.

Soundings made.

Mackenzie District—Geological features.

western portion of the lake, known as Keith bay, together with Smith bay and Dease bay to within thirty miles of Fort Confidence, are surrounded by unaltered and almost horizontal Cretaceous strata. There are few outcrops of solid rocks, but shales and sandstones are exposed along Smith bay, and the Sweet Grass hills represent a low anticlinal fold, composed of hard sandstone, which acts as the backbone of the Gros Cap peninsula Clay-shales, boulder-clays, gravels and unconsolidated sandstone are exposed at various places within the Cretaceous area and these all show a bedding which is almost horizontal. Presumably Cretaceous rocks are also exposed along the shore of MacTavish bay, east of Cape MacDonnel. On the Bear river, the Bear River Tertiary, similar to that already described by Mr. McConnell, at Fort Norman, extends some seven or eight miles up the river, and consists chiefly of unaltered and slightly consolidated sandstones in horizontal beds. Arenaceous shale and thin lignite seams are occasionally interstratified. The beds are often overlain by boulder-clay and cut sand-banks are common. Beyond the Tertiary basin, Cretaceous rocks extend to The Rapid, where a rocky range of Paleozoic strata, crosses the river. Above this, there are frequent exposures of Cretaceous rocks, with some fossils almost as far as Great Bear lake. Here they consist chiefly of dark ferruginous and arenaceous shales overlain by thin-bedded and jointed light-yellow sandstones. Talus slopes are common. The beds dip down-stream at a very slight angle. It is from a stratigraphical and lithological comparison with the rocks of Bear river, that the rocks of Great Bear lake are referred to the Cretaceous, as nowhere on the lake were fossils found. On the upper part of Bear river are horizontal gravel beds of sixty and seventy feet in thickness, overlain by Pleistocene deposits. These gravel beds are probably analogous to those beds of the Mackenzie river which Mr. McConnell there calls Saskatchewan gravels. They are exposed at several places in the Cretaceous area.

Cretaceous rocks.

'Ordovician or possibly Silurian rocks occur at "The Rapid" on the Bear river where the mountain range crosses it. Mount Charles, the most prominent part of these mountains, is a hill of about 1,500 feet in height, and consists of a large anticline, embracing subordinate folds. The rocks are interstratified conglomerates, quartzites and magnesian limestones; the latter of great thickness. I found thin layers of gypsum in several places, interstratified with dark-gray, shaly dolomite. Salt springs are mentioned by Sir John Franklin as occurring here, but I was unable to locate them, and my Indian guide had never heard of their existence, although some thirty miles to the north-westward he knew of salt in quantity. From the description given by Richardson, it is probable that the promontory between MacVicar

Rocks of Mount Charles.

and Keith bays is Devonian, though I think from what the Indians say, Cretaceous rocks must occur there also. Mackenzie District—*Cont.*

'Our route to Great Slave lake from Great Bear lake, lay not far east of the Palæozoic boundary, as could be seen by the outline of the hills to the westward, and at the head-waters of the Marian river; and at Nagle lake, the limestone rocks came to the water's edge. From this vicinity, however, the strike seems to be almost south, while our course was south-east, so that we did not see Palæozoic rocks again, till we arrived at Lake Marian.

'From a point about thirty miles southwest of the mouth of the Dease river, eastward, exposures of solid rocks occur which are analogous to rocks seen last year on Great Slave lake, and there referred by Dr. Bell to the Animikie or Lower Cambrian. A low range of hills follows the shore of Dease bay for a considerable distance, and gradually approaches the lake-shore, till it terminates at a place called by Richardson, Limestone point, some twenty miles from Fort Confidence. The hills seem to be a series of anticlinal folds running almost parallel to Dease bay. Limestone point at its greatest height does not exceed one hundred feet. The lowest exposures are of purplish dolomite, which changes to a ferruginous slate. Above this comes gray, semi-crystalline dolomite, associated with light-gray quartzite. Rocks of like nature occur all the way to the Coppermine river, though isolated and small hills of both granite and syenite occur, which may be of different age. Along the Dease river the rocks consist chiefly of bright-red quartzite and drab and red magnesian limestones. Nearer the Coppermine, quartz-conglomerates, red and green shales, and pinkish sandstones are the prevailing country rocks. Amygdaloid is, however, found, together with some earthy volcanic rocks. In a range of hills running north-east and south-west, probably a spur of the Copper mountains, occur thick intrusive sheets of greenstone, frequently presenting steep mural precipices on either side. These hills rise to a height of about 1,000 feet. Greenstone rocks are also met with, near the mouth of the Dease river. Rocks similar to these occur for a considerable distance around the northern and north-eastern portion of MacTavish bay, and here greenstone intrusions with mural precipices, cutting through horizontal Lower Cambrian strata, are of common occurrence. Cambrian rocks. Green stones

'The eastern part of MacTavish bay is composed of a series of basic rocks, or greenstones, that seem to overlie the Laurentian granites, of which, however, exposures are seen at several places. The southern part of MacTavish bay and the islands there, are mostly of granite, though greenstone dykes are common. Crystalline rocks, composed chiefly of phorphyries, syenites, and granites, with numerous greenstone intrusive sheets, occur all the way from Great Bear lake to

Mackenzie District—

Lake Marian. Hornblende gneiss is exposed on the Marian river. Certain rocks, met with near the headwaters of the Camsell river and near Lake Marian, may be referred to the Huronian system, or possibly they may be analogous to those met with on Great Slave lake, and named by Dr. Bell, the Intermediate series.

Copper ores on Great Bear lake.

'With regard to the occurrence of copper ores in the Great Bear lake country, I may say that in the amygdaloid and associated rocks near the Coppermine, specimens of chalcopyrite and stains of copper carbonate were found, but the locality of native copper, etc., spoken of by the old explorers was not met with, as it probably lies farther south. In the greenstones, east of MacTavish bay, occur numerous interrupted stringers of calc-spar, containing chalcopyrite and the steep rocky shores which here present themselves to the lake are often stained with cobalt-bloom and copper-green. According to Indian report, native copper occurs also at the north-east end of MacTavish bay. Siderite was found in pockets, in quartz and calc-spar in Cambrian rocks on the southern shore of Dease bay. Several other minerals seem to be connected with it. Iron ore in the form of reniform hæmatite, was found, but in uncertain quantity at Rocher Rouge on Edatravers bay, in the north-eastern part of MacTavish bay. Hæmatite also occurs near the Coppermine river and at several localities on the east shore of MacTavish bay. Here the ore is associated with what seems to be a dark reddish trap, which I was unable to identify more precisely in the field. Talus slopes of the ore and country rock are common.

Glaciation.

'Evidences of glaciation, in the form of numerous glacial erratics were everywhere visible from the mouth of the Bear river, but it was not till the harder rocks of the Lower Cambrian were met with that glacial striæ were seen. The general course of the striation is a little north of astronomical west, though great local differences occur. On the barren lands near Dease river, I noticed glacial striæ in a direction N. 85° W. and fainter markings almost exactly at right angles. As Great Slave lake was approached, the course of striation seemed to be much more southward. Rows of drumlins, some of them three or four hundred feet in height, and long winding eskers were seen near the head-waters of the Dease river, and near Dismal lake, kames occur.

Old shore lines.

'Modern ice deposits are seen on the Bear river and are being annually added to by the ice freezing to the bottom around the shallow shores of Bear lake, and in the spring the ice rises and carries away pebbles, sand, and sometimes even boulders of good size. Around Great Bear lake wonderful examples of old shore lines occur, showing the former extent of the lake. On the north-west side they exceed, in places, three hundred feet in height, and are at a distance of three

to four miles back from the lake shore. This height on the north is much greater than any observed on the southern side, which might show a tilting of the lake towards the south or south-west. Besides these, broad beaches of one hundred to one hundred and fifty yards were often met with, and in places terraces of pebbles, showing old shore lines, extend for a short distance from the present shore of the lake, at various heights of from ten to one hundred feet. These are especially common in the northern part of MacTavish bay. Mackenzie District *Cont.*

'The country abounds in game. Grizzly and black bears were frequently seen, and Polar bears on the Coppermine river. Caribou are abundant around the northern and eastern shores, and a few musk-oxen were seen. Moose are to be had in plenty from MacTavish bay southward. All the ordinary northern waterfowl were abundant, and the waters of not only Great Bear lake, but all the lakes to the south of it, teemed with splendid fish. Game.

'A careful collection of the flora of the country was made and about 150 species were obtained. I was greatly assisted by Mr. C. Camsell in the collecting of botanical specimens. The Bear river, and all the country from MacTavish bay southward, is well wooded and fine specimens of white spruce, canoe birch, and poplar of both kinds occur. On the north-western shore of the lake spruce trees, sometimes eighteen inches in diameter, were seen, at a distance of three to four miles back from the lake on the sandy hills, but near the shore the country is either very sparsely wooded or not wooded at all. On the northern shore, until near old Fort Confidence, the country is very thinly wooded with stunted spruce and willows, and these only at some distance back from the shore; and the same conditions are seen around the southern shore of Dease bay. In MacTavish bay, in the shelter of the rocks, occur some fair-sized spruces, with some stunted birch and poplar, which were observed here for the first time in going south. Banksian pine is not seen until reaching Lac Fabre but from there south, it becomes an important forest tree. The Northern limit of tamarack is near the mouth of the Camsell river. Around old Fort Confidence and about twelve miles up the Dease, the country, strange to say, is well wooded with spruce. Beyond this, spruce practically disappears, though occasional clumps of stunted trees were seen. Trees of fair size were observed on the Happy river, a tributary of the Coppermine. Willows were also found at several favourable spots on the Barren Lands. Timber.

'Acknowledgments are due for assistance in carrying out the exploration, particularly to Mr. F. C. Gaudet, with whom I spent the winter, Mr. J. S. Camsell and the various officers of the Hudson's Bay Company, Messrs. Hislop and Nagle, and the missionaries, both Roman Catholic and Protestant.

Ontario.

Ontario.

After preparing his preliminary report for the previous season, Mr. W. McInnes spent the remainder of the winter in plotting the surveys of the summer of 1899, and in work upon the Manitou and Ignace sheets, the former of which is about ready for the engraver, and the latter in course of preparation.

Work by Mr. Wm. McInnes

Mr. McInnes' work in the field during the past season was mainly directed to the exploration and mapping of the area of sheet No. 8, Ontario, to the south-west of Port Arthur, and extending to the International boundary. Upon the progress of the work Mr. McInnes makes the following report:—

'Leaving Ottawa on May 30th, ten days were spent by permission of the Director in examining the iron ore deposits of northern Minnesota, preparatory to an examination of the same series of rocks in their extension into Canada. In pursuit of this object the mines at Tower, Ely, Biwabic and Eveleth were visited and a number of sections examined along the railways and roads in the vicinity of these towns. The few days spent here proved most instructive and the experience gained will be of good service in connection with working up the iron ores on our own side of the line.

Iron ranges of Minnesota.

'The iron ranges of Minnesota, which are so extensive and of so great value, belong to two distinct geological horizons with characteristic ore deposits in each. The Vermilion range represents the older horizon. In it occur the deep mines at Tower and Ely. The ores mined are hæmatites of the close-grained metallic description known as "hard ores," though only those at Ely are typically hard.

'At Ely good sections were seen of the surface exposures of rock, and these were found to be quite similar in general character and mode of occurrence to our Keewatin iron-bearing belts. This belt has now been traced on the ground into actual continuity with our Keewatin areas of Hunters island. There seems to be a prospect, therefore, that some of the many known iron-bearing areas occurring in these rocks on the Canadian side may show deposits of good workable ore.

Continuous with Keewatin areas of Hunters Island.

'The upper iron-bearing horizon is represented by rocks of the Mesabi range which are, without question, a part of our Animikie formation. It is, generally speaking, a flat-lying series of rocks with, however, generally undulations and minor local crumpling. On this range occur the remarkable "soft ore" deposits, some of which allow the most economic mining methods to be employed—the direct transfer of the ore from the beds to the railway cars by steam shovels. One-half or perhaps more than one-half of the Mesabi ore is thus mined. The whole region is, in the main, deeply covered by drift deposits, making

the first discovery of the ore lenses a matter of great difficulty—so Ontario—Geol.
difficult that, although the region has been closely prospected for years, the area of workable deposits has been widely extended through prospecting by means of test pits and the diamond drill within the last year.

'The position of these deposits, near the base of the Animikie, makes it a matter of probability that similar beds of ore may be found in Canada, where we have a wide area covered by these Animikie rocks. Roughly described, this area occupies a triangular space bounded by Lake Superior, the United States boundary, and a line extending from Gunflint lake north-easterly to the shores of Thunder bay. Probability of similar beds in Canada.

'Iron ores of good quality, with a high percentage of iron, have been discovered at a number of points over this area, but up to the present time none have been proved to be in sufficient quantity for practical working. These ores consist mainly of magnetites, hæmatites, limonites and carbonates. The iron-bearing district is now well served by railways, the Canadian Pacific, the Canadian Northern, and the Port Arthur, Duluth and Western all traversing it. The haul to a lake port would not be any longer than is the case in Minnesota and often much shorter. In the case of the Vermilion range of Minnesota the haul to the shipping docks at Two Harbours is over 100 miles, and that from the Mesabi to deep water but little less. The sections exposed in the Matawin valley and on Hunters Island seem to be those most closely parallel to the Vermilion beds, and in both of these places deposits of iron ore of considerable extent have been found. Facilities for shipment.

'Mr. E. J. Meyers, of Listowel, who had been assigned to my party as an assistant, joined me at Port Arthur on June 11th. After collecting canoes and outfit that had been stored over winter at Ignace station, on the Canadian Pacific railway, and engaging Indians, etc., the first train on the P. A. D. & W. railway was taken to Gunflint lake, the terminus of the Canadian part of the road.

'A few days were then spent in an examination of the shores of Gunflint lake. Gunflint lake and the country in its neighbourhood. The eastern edge of the Saganaga granite area reaches the western end of the lake, and the granite is at no place more than about a mile back from the lake to the north, a belt of Keewatin and often a rim of Animikie lying between the granite and the shore. The immediate basin in which the lake lies and the bordering hills to the south are Animikie, and belong to the lower iron-bearing portion of that formation. These rocks as a whole lie almost horizontally, with but slight undulations. The high hills to the south show thick exposures of black slate, with a capping of trap, and with sills of trap showing here and there at different levels in the slates. Below the slates is the quartzite division,

Ontario--*Cont.* made up of hard quartzites, with interbanded chert, jasper and iron ore, ferriferous dolomite, etc. To the north of Gunflint lake an iron-bearing band extends from Magnetic lake to beyond LeBlain station, lying about a mile back from the shore and trending parallel to it. As no development work has yet been done, it is impossible to say with certainty from the limited surface exposures what its extent or possibilities may be.

'The unconformity between the overlying, horizontal Animikie and the nearly vertical Keewatin is well seen in the section afforded by the cuttings along the line of the P. A. D. & W. railway.* The Keewatin is here made up of green schists, altered argillites and quartz porphyries with, at one point, a schistose band from four to five inches in thickness, coated and seamed with pyrolusite.

Gunflint river

'On June 27th, a start was made down the Gunflint river, for the purpose of further exploring the country lying to the north and east of Saganaga lake. The granite-gneiss is struck on Magnetic lake, immediately beyond the Animikie ridge dividing this lake from Gunflint. Continuing down the river, the same gneiss striking about N. 70° E, is seen down past Flat-rock portage, where there is a descent of ten feet and at Mill falls, with a descent of twenty-five feet.

'Below, at Island falls, with a descent of forty feet, the gneiss is less decidedly foliated and the prophyritic crystals of quartz, characteristic of the Saganaga granite area, show prominently on weathered surfaces. The same obscurely foliated gneiss or granite is seen all the way down the river to Saganaga lake, where it is defined pretty closely by the shore line, the granite appearing only on projecting points, with, generally a closely-cut line of intrusive contact between it and the Keewatin.

Saganaga lake

'A micrometer survey was then made of the long easterly arm of Saganaga lake and of the corresponding long westerly arm of Northern Light lake. The main Saganaga lake had been surveyed by the late W. H. Smith of this office and Northern Light lake by H. B. Proudfoot, O.L.S., for the Ontario government, so that this survey was carried only far enough to establish a good tie between them. Granites of the Saganaga area extend to the end of the Saganaga arm, and granite-gneisses of the typical Laurentian character occur all along the line of Northern Light lake.

'After tying the survey to Sewell's base line, Northern Light lake was examined to its south-eastern end. Banded biotite-granite-gneisses were found all about the lake, the strike gradually swinging from N. 40° W., at the north to S. 80° E, at the narrows, and to N. E. about the south-easterly bay. Our return to the railway was made by way of Twin lakes and a number of smaller lakes and

* Port Arthur, Duluth and Western railway.

ponds, a route involving six portages and passing over biotite-gneisses to within about 300 yards of the railway at North lake, where the horizontal beds of the Animikie come in. Returning through North lake to Gunflint, after making a number of sections over the hills and along the railway, the route down the river to Saganaga was again taken for the purpose of examining the country to the north and north-west of Northern Light lake. A micrometer survey was started at Sewell's base-line and carried up Sand river about two miles, where a branch coming in from the north-west was taken and followed up to the lake at its source about two miles and a half long. A route through a number of small lakes to Kinnimikwisas lake, was then surveyed. This lake is four and a half miles long, with very irregular and broken shore lines. Obscurely foliated biotite-granite-gneisses were found all along. Returning through Conmee and Mowe lakes the same gneisses were observed all the way. The country passed through, everywhere showed evidences of glaciation, the glacial striæ averaging about S. 20° W., in direction. Coming out by way of the outlet of Northern Light lake, this was found to empty, from the bay running westerly from its southern end, into Long Bay of Saganaga.

Routes surveyed.

'North lake, South lake, Mud lake, Rose lake and Arrow lake were then examined, and good sections of the Animikie rocks were seen in the cliffs bordering them. Soundings showed these to be the deepest lakes visited. A few of the greatest depths obtained are :

Depth of lakes.

	Feet.
Gunflint lake	208
South lake	147
Northern Light lake	123
Saganaga lake	121
North lake	114
Mowe lake	72
Rose lake	65

'The lower part of Arrow lake is evidently deep, but no soundings were made. A micrometer survey was made of Whitefish lake and a tie line run to the railway. This lake, though about six miles long by two miles wide, is exceedingly shallow and is apparently gradually filling up. Wild rice beds occupy many of the large bays, and are constantly extending farther and farther out into the main lake, which averages less than seven feet in depth. Whitefish are still caught in the lake in small quantities, but constant fishing for a great many years, without any provision for restocking, has sadly diminished the large catches of former years. Arrow lake is fished for both lake trout (*Salvelinus namaycush*) and whitefish, and the former are taken in considerable numbers. Both lakes lie entirely in the Animikie, the high hills to the south showing in places perpendicular cliffs of slate,

Whitefish lake.

Arrow lake.

Ontario Govt. overlain by a capping of trap, and the hills to the north, of more moderate height, exposing the lower division of the Animikie. Bands of iron ore of good quality are found in these beds north of Whitefish, but as far as observed, they are limited in quantity. A few veins carrying silver have been found in these rocks, but none are being worked.

Sections on railways.

'The remainder of the season was spent in examining the cuttings along the Canada Northern and P. A. D. & W. railways as well as the various colonization roads that are being opened up by the Ontario government.

'A number of short excursions were made through the bush to the north of the railway. One of these gave a section northward from the 45-mile post. From the railway, the lower division of the Animikie was found to extend back for about two miles, or to a quarter of a mile beyond the Star mine, where it gives place to the underlying biotite-granite-gneiss. Continuing, the gneiss only is seen through the township of Strange and on beyond Trout brook, trending in parallel east-and-west ridges.

Outpost hills.

'About three miles beyond the north line of Strange, the farthest of the Outpost hills rises, the lower slopes being composed of gneiss, and the more steeply sloping top of Animikie quartzites, etc. A band of iron ore of good quality can be traced for some distance along the hill, but the surface exposures do not show a great quantity. A flat-lying bed of trap forms the summit. The general denudation has been so great as to leave the hill of Animikie quite isolated on the gneisses.

Agricultural land.

'The south-eastern part of the region included in the map-sheet embracing about two thirds of its area and underlain by the flat-lying beds of Animikie, is covered generally by a thick mantle of drift, through which the flat-topped hills of trap protrude. This may be considered as being generally good agricultural land, the soil varying from a heavy clay to a light sand. Along the various river valleys are broad tracts of excellent alluvial soil well suited for general farming. The valley of the Little Whitefish is a good example of this kind of land. The district generally is particularly well adapted for the growth of root crops as well as hay and clover, the latter, where it has been accidently sown along old lumber and colonization roads, growing most luxuriantly. The severity of the winter climate is the greatest drawback, but that it is not so rigorous as to prevent the growing of reasonably hardy fruits, seems to be proved by the strong and well fruiting plum trees (*Prunus Americana*,) that grow wild throughout the district.

Timber.

'The principal forest trees are red and white pine, Banksian pine, spruce, fir and tamarack among the conifers, and poplar, elm, ash, white birch and soft maple.

'The rule obtaining with reference to the distribution of brook trout farther north, was found to hold good here also. All the streams flowing into Lake Superior, where no unsurmountable fall intervenes, teem with brook trout, while in those across the height-of-land these fish are entirely wanting. Lake trout are widely distributed, and white-fish occur wherever suitable conditions exist. Pickerel and pike are common in most of the lakes, and suckers are everywhere abundant. Ontario--*Cont.* Fish.

'Moose and caribou are plentiful and appear to be increasing in numbers, and Virginia deer are coming up from the south followed by their enemies, the timber wolves. Bears and other common fur-bearing animals are trapped during the season. Ducks of various species are plentiful wherever rice beds furnish good feeding grounds, but only a few kinds breed in the district. Grouse, including the pin-tail, are fairly plentiful. Game.

'The only mine at present being actively worked is the "West End" silver mine of Silver mountain, which is being operated by a syndicate under lease. At the time of my visit I was permitted, through the kindness of Capt. Shear, to examine the mine and mill. Rich ore was being taken chiefly from the upper levels. The very high grade ore is barrelled for shipment as it comes from the mine, and the lower grades are run through the stamps and concentrated for shipment in sacks to the smelter. Mining.

'In connection with the mill, the company have erected a trial excelsior plant, for the production of excelsior packing from poplar and other woods, that can be cut in quantity near at hand.

'Work was resumed late in the summer on the old Polson iron location, situated at the end of the P. A. D. & W. railway, just across the border, in Minnesota. A new company which has taken hold of the property, was engaged in September in freeing the old works from water with a view to thoroughly testing the location. On the Canadian side, prospecting parties have been active in Hunters island and north of Saganaga, and it is claimed by some of them that iron-ore in commercial quantities has been found. In the north-western part of the township of Marks, exploratory and preliminary testing work was being done on an iron-bearing band that has been located there.

'Mr. Meyers, owing to an accident that laid him up for a month or more, was forced to return home early in the summer. During the remaining time Mr. A. J. Carlyle of Woodstock acted as my assistant.'

Michipicoten District.

Dr. Robert Bell was engaged during the summer in Michipicoten district, north of Lake Superior, where he had previously spent the greater part of the season of 1898, and which he had visited also in previous Work by Dr. Robert Bell

Ontario--*Cont.* years. The recent discovery of extensive deposits of iron ore have rendered the district a specially important and interesting one. Dr. Bell reports as follows on his work :—

'I left Ottawa on July 27th, accompanied by Mr. W. J. Wilson, of the Geological Survey, who was to act as my assistant, and at the close of the season we returned to this city—on November 6th. On the way up we stopped at Sault Ste. Marie long enough to hire canoemen and to send forward the canoes I had in store in that place.

Michipicoten. 'On arriving in Michipicoten bay, I found the surroundings had been considerably transformed in less than one year, in consequence of the discovery of a large body of rich iron ore at Boyer lake, about eight miles north-east of the mouth of Michipicoten river. The first cove to the north-eastward of Gros Cap had been dredged and converted into a shelter for vessels and named Michipicoten harbour. It had been made the starting point of a railway, twelve miles in length, to the iron deposit, which had become known as the Helen mine. The passenger steamers called at this harbour, and a post office had been established under the same name. Being thus the most convenient centre for our operations, we made it headquarters for the season, instead of Michipicoten post, as in 1898.

Recent developments.

'The topography and geology of the area covered by sheet 143, Ontario series, which lies in this district, had been partly worked out by myself in connection with explorations of the surrounding country in 1875-76-77 and in 1881, and they were represented on the map of the basin of Moose river, published in 1882. In 1898, in consequence of the discovery of gold in that region in the previous year, topographical and geological work of a more detailed character was done there by myself. The western part of the sheet was thus fairly well completed, and it was described in my summary report for that year. On account of the discovery in 1899 of the large deposit of iron ore in this section—now worked as the Helen mine—it became desirable to make additional geological examinations in the same area. Further surveys were required in the eastern part of the district, in order to complete the whole sheet for publication. The Helen mine deposit and other discoveries of iron ore recently made in this part of the country were, therefore, investigated and their geological relations studied with the object of enabling us to indicate as nearly as possible the run or position of the iron-bearing horizon or horizons in those parts of the district where ore has not yet been actually found.

Former work in the district.

Mr. Wilson's work.

'The following topographical work, with geological notes, was done by Mr. W. J. Wilson : A paced survey of the newly opened trail from Tremb'ay station, on the Algoma Central railway, north-westward for about twenty-five miles, track-surveys of a canoe-route from Michipicoten river by Angigami lake and thence southward, of the whole of Winder-

mere lake, of a route from this lake northward across the height-of-land and down a stream towards Missinaibi lake, of Mattagaming lake, of a route from Manitouwik lake north-westward to and including Jack fish lake, besides minor investigations in other parts. He also assisted me in various ways in connection with our labours towards the accomplishment of the objects of the season's operations. I may here remark that Mr. Wilson performed the various duties devolving upon him in a very efficient and satisfactory manner. Ontario--*Cont.*

'My own topographical and geological work included a track-survey of a route from Wawa lake to the Josephine mine, and of the various connecting lakes, a traverse through the woods from Tremblay station northward for nineteen miles with offsets to Black Trout lake and Catfishing lake; geological examinations of the Helen mine and the railway track between it and Michipicoten harbour; the same of the shore of Lake Superior from Michipicoten river westward nearly to Pilot harbour, with explorations inland at Doré river and Dog river. A track-survey of a chain of lakes from Windermere lake to and including the west branch of Montreal river and the main stream downward to the southern margin of the sheet; the same of Montreal river and the lakes on its course upward from the junction of the west branch to the height-of-land, south-west of Chapleau; the same of the large lakes at the head of Kapuskasing river and of this stream from these lakes downward to a point about sixty miles north-north-eastward of Chapleau, where I tied this survey to a similar one made by myself in 1881, eastward through various lakes and streams from Missinaibi river to Trout river; a track-survey of some lakes lying west of this part of the Kapuskasing river; the same of White river from the line of the Canadian Pacific railway to Pokay lake, and thence through a chain of lakes to and including Kaybinik lake; a similar survey thence through a chain of lakes and streams westward to the head-waters of Dog river and on to Iron lake; examinations of iron deposits and their associated rocks in this region. While making the above surveys and explorations, many observations were taken for latitude. In passing over ground which had been previously examined, additional facts as to the geology and other matters were frequently noted. Dr. Bell's work.

'Mr. E. V. Clergue, manager of the Algoma Central Railway and Steamship Company, had a number of topographical and geological explorers out in the Michipicoten district during the present and the previous season, in addition to the engineers engaged in locating the railway and its branches, and from time to time he kindly placed the results of their labours at our disposal, as well as the compilations of some of their maps prepared by Mr. Lawrence. This material will be of much service in supplementing our own and other surveys Other explorers' work.

Ontario—Cont.

in the construction of a final geological map of the district. Among the principal data now available for this map may be mentioned the straight lines run at various dates by Messrs. Salter and Gilmour, Herrick, John Fleming, Speight and Niven; Stewart's surveys on the right-of-way of the Canadian Pacific railway, surveys for the Algoma Central railway, Bayfield's chart of the shore of Lake Superior, and my own instrumental survey of the same shore within the limits of the sheet, topographical and geological explorations made by a number of different persons in 1899 and 1900, under the direction of Mr. Clergue, inland surveys by myself and assistants in 1898 and previous years, all supplemented by the work of Mr. Wilson and myself in 1900.

Data for map.

'Mr. Wilson's work on Mattagaming lake, above referred to, and part of my own in 1898 on the Magpie river, lie beyond the north line of sheet 143, and are in the area that would be covered by the next sheet to the north, namely, number 156. These surveys and researches were necessary in order to complete the geology of the large Huronian basin of the Michipicoten region and they, together with my topographical and geological surveys and explorations in previous years in the rest of the region covered by this sheet, leave little to be done in that area. North of the Michipicoten Huronian basin, with the exception of the small bands of the same series occurring at Kabinakagami lake, the rocks within sheet 156, consist entirely of common Laurentian gneiss.

Work beyond limit of sheet.

'The character and distribution of the rocks of the area covered by sheet 143 are described in my summary report for 1898. The various explorations made by Mr. Wilson and myself, as above described, in the eastern half of the sheet, brought out no new facts in regard to the general distribution of the Laurentian and Huronian systems, and they confirmed the accuracy of the geological boundaries as laid down on the map of the basin of Moose river, published in 1882. As represented on that map, only Laurentian rocks were found on the Angigami river route, around Lake Windermere, thence to the west branch and down the main Montreal river and up the same stream to its source near Chapleau, also for a long distance down the Kapuskasing river. The general position and contour of the boundary of the Huronian basin to the northward of our present sheet, as given on the above map, were also confirmed.

Confirmation of geological boundaries.

'Beyond the western boundary of the sheet, the Huronian rocks were found as far as Iron lake, and they continued still further west, but this lake is considerably beyond the limits of the sheet and my explorations extended no further in that direction. Mr. Robert Murray, in charge of the Iron Lake mine, informed me that the Huronian rocks continued on beyond the Puckaswa river, where Professor Coleman found them in 1898.

Western extension of Huronian basin.

'The red granite area on the shore of Lake Superior, between Doré and Dog rivers, at the western edge of the sheet, has a breadth of only about three miles on the lake front. West of the granite, the shore is occupied by green schists, having a constant north-north-westerly strike for a distance of fifteen miles, when red granite again appears. It may be inferred from the great width of this body of schist and the regularity of its strike that it continues inland in the same general direction for a considerable distance. Ontario--*Cont.* Geology of Shore of Lake Superior.

'The granite first referred to, between Doré and Dog rivers, is the southern part of what is apparently a large isolated area, extending north to Kaybinik lake and thence westward for some miles, although in this part of the district the exposures of granite and green schist alternate in such a way that it is possible some of the former may belong to smaller isolated areas. The most easterly part of the boundary of this large granite area touches Black Trout lake. Isolated area of granite.

'The wide belt of coarse conglomerate, which is so conspicuous on the shore and islands on both sides of the mouth of Doré river and thence eastward to the hills in the rear of Michipicoten harbour, seems to turn north and disappear before reaching Magpie river. In the opposite direction, it is seen at Dog river, running north-westward. Some of the explorers who have worked in the Michipicoten district suppose that the iron ore belt may be looked for in connection with this great band of coarse conglomerate, but I have not seen any conglomerate east of the Magpie river that can be correlated with it or that can be regarded as a guide for locating the iron belt. Although the iron ores of the eastern part of the sheet do not appear to run near any conglomerate band, the iron belt of the western part of the district lies along the north side of a wide band of conglomerate resembling that at the mouth of Doré river. Conglomerate or breccia occurs at the outlet of Black Trout lake and again at the site of the former bridge across the Magpie river on the old tote-road from the head of Wawa lake to Grassett on the line of the Canadian Pacific railway, but at neither place has the rock the volume or general character of the Doré river band, although it may be possible that the conglomerates at these localities represent it in a modified form. Some of the rocks of the iron belt itself are broken up into breccias, as, for example, those on the south side of Moon lake and at Scott lake, but these are in no way connected with the strong band of coarse conglomerate above referred to, which is composed of water-worn stones of a different character. Both weathered and freshly broken surfaces of different kinds of schist throughout the Michipicoten Huronian basin, occasionally show scattered patches of various sizes, which differ more or less from the surrounding rock as to colour and sometimes also as to the relative proportions of their constituents. They Coarse conglomerate belt. Other conglomerates.

present angular, rounded and elongated outlines in cross section. These occurrences can scarcely be regarded as constituting conglomerates.

Jaspery ore-belt.

'The first appearance of the "jaspery" ore-belt on which the Helen and Josephine mines are situated is at Moon lake, from which it is traceable north-eastward past Sayer lake to the former mine, and thence onward in the same direction, passing between Wawa and Eleanor lakes to Scott lake and Park lake. From the last mentioned lake, it is supposed to run north-east, parallel to the south-eastern boundary of the Huronian basin, nearly, or quite, to Mattagaming lake. A ferruginous rock which occurs at one place on the north-west side of this lake, between the outlet and Waboose island, may perhaps represent the continuation of this belt.

The Josephine mine.

'The Josephine mine is situated at the south-west end of Park lake, on the same ore-belt as the Helen mine and at a distance of about seven miles in a straight line to the north-east of it. The ore consists of red hæmatite interstratified with thin beds of white and gray quartz-rock or "jasper," like that found elsewhere along this iron belt. During the previous winter two bore-holes had been put down, each at an angle of 45° to the horizon, and outward, or in opposite directions, from a small island in the lake, so as to cross the strike of the iron-belt which here stands nearly vertical and runs about north-east. I could not ascertain the result of these borings. A little stripping had been done on the mixed hæmatite and quartz layers, where it is proposed to develop the Josephine mine at the south-west extremity of Park lake.

Gros Cap iron band.

'The occurrence on the south side of Gros Cap of a band of alternating thin layers of quartz and hæmatite, was referred to in my summary report for 1898, and it was more particularly described in my detailed report for 1876. A smaller ferruginous band occurs on the south side of the rocky peninsula on the north side of the mouth of the Michipicoten river.

The Helen mine.

'*The Helen Mine.*—The existence of iron ore at what is now the Helen mine, is said to have been known for two or three years to certain trappers and explorers, one of whom, Benjamin Boyer, brought it to the notice of Mr. H. F. Clergue in 1899. The latter purchased the location, and immediately proceeded to develop it as a mine. The occurrence lies at the east end of a deep pond, about a quarter of a mile long, called Boyer lake.

Character of the ore.

'The ore is a hard but somewhat porous or spongy red hæmatite, with a specific gravity of about 5. The ore-body, from which a layer of muck or peaty moss has been removed, forms a point dividing the head of the lake into two small bays. It has a lumpy surface with

a dark bluish-gray colour. Small quantities of brown hæmatite (limonite) and yellow ochre appear in joints and cavities, but they do not form any appreciable portion of the mass. Ontario--*Cont.*

'The horizontal dimensions of the exposed ore are about 500 feet in every direction, and its greatest height above the lake is 100 feet. The ground rises steeply all around the head of the lake, so that the ore lies at the bottom of an amphitheatre, open on the west or lake side. A drift has been run at the level of the general surface of the ore, southward into the hill, and this penetrates similar hæmatite for 250 feet, thus giving a known breadth of about 750 feet from north to south.* During the winter of 1899-1900, by taking advantage of the ice on the lake, a number of holes were bored in the bottom along a north and south line, which passed the extremity of the point of ore at a distance of 250 feet to the westward. On this line and abreast of the point the lake had a depth of 100 feet, including ten feet of soft mud, and at 150 feet below the bottom, where the boring ceased, the drill was still in hæmatite like that on the dry land. A bore-hole from the surface of the exposed ore was sunk to a depth of 188 feet below the level of the lake without reaching the bottom of the hæmatite. The ore-mass has thus been proven to have a continuous depth of 300 feet, and as this follows the plane of the bedding, which is vertical, the probability is that the depth is very much greater. The general strike is parallel to the axis of the pond, which is about east and west. The railway approaches the mine from the west along the foot of the hill on the south side of the lake. Measurements of the ore-body.

'The rocks rising steeply from the railway track a short distance west of the ore deposit, and about in line with its southern side, consist of dark, greenish-gray diorite, and a soft, light-gray arkose schist. On the north side the ore-mass is bounded by a considerable hickness of thin layers of hæmatite, like that of the main body, interstratified with others of quartz rock. These alternating beds are from half an inch to three or four inches in thickness, and the mass is similar to the "jasper belt" traceable some miles to the east-north-east, in the general strike of these rocks. Associated rocks.

'The ground rises to a height of 440 feet, according to our barometer, at a distance of about 1,500 feet east of the mine. The hill is called Hæmatite mountain, and the rock on its summit consists of light bluish-gray carbonate of iron (siderite) containing 36 per cent of metallic iron, according to the analysis made in the laboratory of the Survey. Where it has been exposed to the surface influences, it becomes encrusted with two or three inches of dark brown limonite, containing 52 per cent, of metallic iron. A light, yellowish-gray siderite, holding much finely divided silica, occurs near the northern side of the mine. Hæmatite mountain.

*Mr. E. V. Clergue informs me that the distance from the head of this drift to the extremity of the ore point is 975 feet.

Ontario—*Cont.*

Siderite.

'Boyer lake is about 1,500 feet in length. On the south side of its outlet there is a purer variety of siderite, of the same colour as the last mentioned, which also passes into dark brown limonite on the surface. The lake discharges by an artificial trench cut through a narrow ridge of rock, along a bed or vein of impure, finely granular

Iron pyrites.

light-yellow iron pyrites. A width of about six feet of the pyrites is exposed. Similar pyrites in larger quantities occurs on the south side of Sayer lake, which is about 25 feet below the level of Boyer lake. In a railway cutting on the north side of the former lake, there is a good fresh section of the unaltered rocks of the iron belt, in a zone corresponding to that of the hæmatite and quartz rock on the north side of

Fresh section of siderite and chert.

the Helen mine. They consist of thin alternating beds of siderite and chert. The former is mostly of a light yellowish colour, while the latter is of all shades of gray, from nearly white to nearly black. The alterations to which both rocks are subject everywhere in the district, may be seen at this locality, the siderite passing into limonite and hæmatite, and the chert into a fine-grained, soft freestone, or 'sugar-stone.' Sayer lake discharges over a ridge of rock into Moon lake, which is 78 feet lower. Along the railway, from the outlet of Sayer lake to within 50 chains of Moon Lake station, the laminated rocks of the iron belt are well exposed in the cuttings. Here they have been

Breccia.

thoroughly broken up and brecciated. The contrast in colour of the two components, as shown on the recently exposed surfaces of the breccia, is soon increased by exposure to the weather, the siderite rapidly deepening in shade, while the chert, which is mostly light, shows out strongly as spots on the yellow and brown surfaces of the siderite.

Origin of the iron-ore.

'The great mass of hæmatite at the Helen mine appears to have resulted from the alteration of an enlarged portion of the siderite band. Although the change occurred long after the upturning of the strata of which the siderite band forms a part, it must have taken place at a somewhat remote period, or long before the pre-glacial changes which produced the existing physical features of the region. The present surface of the ore-mass shows glacial striæ running S. 2° E. Some detatched masses of the ore, derived from the bottom of the valley now filled by the lake, have been elevated by glacial action and deposited on the slope and top of the hill along the southern side of Boyer lake. As already stated the general attitude of the bedding in the vicinity of the Helen mine is vertical and the strike east and west, but immediately around the ore-mass some disturbance of the strata has taken place, and this may have been connected with the alteration of the large body of siderite.

'The boundaries of the ore-mass are not known with sufficient accuracy to enable us to make a correct estimate of the total quantity of ore which may be present at the Helen mine. But since any calcu-

lation may be better than none, the following can be given as a rough approximation, based on such facts as we have. The present exposed surface of ore measures, from north to south, about 500 feet, and the width is increased, by 250 feet in the drift, or say 750 feet in all. From east to west the exposure of ore measures also about 500 feet and this length is increased by 250 feet westward from the extremity of the point by the record of the bore-holes, so that there is a known length of 750 feet. The report of the Ontario Bureau of Mines, dated 1900, gives the horizontal dimensions of the exposed surface of the ore-body as 650 by 850 feet. This would show a superficial area of 552,500 square feet, while the dimensions above stated would make it 562,500. The ascertained depth of the ore on the general plane of the bedding is 300 feet, namely 50 feet from the surface of the deposit to the level of the lake, 100 feet for the depth of the lake, and 150 feet in the bore-hole below the bottom. The breadth is as likely to expand as to contract in going down and we may safely assume that the walls descend about perpendicularly for the limited depth of 300 feet. If the deposit be supposed to be terminated by vertical planes at right angles to the strike, at the above distance apart, instead of allowing for its extension to a considerable length to the east and west, as would naturally occur in the case of an interstratified bed such as this, the content of the mass which may be considered as proved to exist, (after allowing for the portion within the above measurements occupied by the water of the lake), would amount to about 26,000,000 tons of ore. Until the actual dimensions of the deposits are more accurately ascertained, it will be impossible to say what proportions the above measurements bear to the whole mass of ore actually present. Possible irregularities in the walls of the section here given may somewhat diminish or increase the above estimated tonnage, but any variation on this account from the above figure will probably not be large.

Ontario--*Cont.*

Estimate of quantity of ore in the Helen mine.

'Such a great mass of ore, having the form of this deposit, may naturally be expected to be continued in considerable force beyond the above stated limits, both as to depth and extension on the strike. It would not be surprising if the mine should produce more than double the above quantity of ore before it becomes exhausted. Three hundred feet, the depth to which it has been tested, is much less than we might reasonably expect a deposit of this magnitude and geological character to have, considering the fact that the strata are standing vertically. The occurrence of a considerable body of siderite on Hæmatite mountain, about 1,500 feet east of the mine and another at the outlet of Boyer lake about 1,500 feet west of it, with the mine itself on the line of strike

Probable extent.

Ontario Govt. between the two localities, indicates the extension of the hæmatite mass into the hill to the east and under the lake to the west.*

'*Iron ores in the Western Part of the District.*—At the McDougall and Iron Lake mines, lying westward of the north-west corner of the sheet, the ores are also red hæmatite, and they are in immediate association with a quartz-rock. At the former locality, no other rock is exposed, but the east and west strike of certain green schists and diorites not far off, would carry them past the mine at about three quarters of a mile to the north. The ore consists of a good quality of red hæmatite, of which three seams about 3, 6 and 5 feet in width, respectively, have been opened by test pits. The associated grayish quartz-rock is more or less distinctly ribboned or banded and it is disturbed in some parts of the ridge on which the mine is situated. The general strike is due west.

The McDougall mine.

'At the Iron Lake mine, seven miles to the west of the last, the quartz-rock holding the ore is also disturbed, but the general strike is S. 70° W. Various test pits had been sunk over a considerable area at this place which showed four bodies of good red hæmatite, ranging from 5 to 10 feet or more in thickness at the surface. The quartz-rock and hæmatite are associated with a silicious gray schist, and together they form what is locally called the iron belt, which has a breadth of from 10 to 20 chains and has been traced for about four miles to the west-south-west of the head of Iron lake. This belt is bounded on the north side by green schist and diorite and on the south by a wide belt of coarse conglonerate, of which the stones are mostly granite, thus ressembling the conglomerate at the mouth of Doré river.

The Iron Lake mine.

'*Gold.*—Since the date of my summary report for 1898, little progress has been made in testing the value of the gold-bearing quartz veins of the Michipicoten district discovered in 1897. The delay has been owing to a want of capital to make a thorough trial of some of the most promising discoveries. Among those who first interested themselves in this field were several enterprising men, but they failed to obtain or to lay out the money that would be required to properly test the commercial value of any of the numerous veins which were prospected to a certain extent. The Algoma Central Railway Company has now taken the matter up, with the determination to prove at least one vein. They are sinking a shaft, now sixty feet deep, at the Grace Mine location, situated not far from the foot of the Long Portage on the Michipicoten river, in a fissure vein three feet wide

Gold.

The Grace mine.

*Mr. E. V. Clergue informs me that the ore shipped from the Helen mine during the year 1900, contained an average of about 61 per cent. metallic iron and 0·08 phosphorus; also that at the point where the ore-body comes to the lake a bessemer ore is found running as low as .02 to .03 per cent in phosphorus and in sulphur from a trace to .05 per cent. The ore has a high grade in the market also on account of its low percentage of water.

of quartz showing free gold: and if the size and richness continue Ontario—Coast
and should warrant the erection of machinery, it is proposed to build a stamp mill in order to give the ore a sufficient commercial test. Some work was reported to have been done during the summer of 1900 on the Diamond Jubilee gold mining location in the same vicinity.

'In 1898, when my attention was more particularly directed to the Collection of samples.
gold of the district, I took samples from twenty different "prospects" I did not accept any specimens offered me, but at each locality, I broke my own specimens from the solid vein. I tried in all cases to get fair average specimens of the quartz, and for this purpose a number of samples were sometimes taken from different parts of the same vein, and these were afterward all crushed together for assay. Careful assays Assays.
were made of all the above samples in the laboratory of the Geological Survey. Out of the above twenty, gold was found in seven, or a third of the whole, but only as traces in four cases. The other three showed the following results: Kamisho's mine, on a high hill behind Pointe Brûlé, one piece, weighing ten ounces, contained gold at the rate of Amount of gold.
0.233 of an ounce to the ton of 2,000 pounds: Jubilee mine, specimens from vein at mouth of shaft, ten fragments, total weight, three pounds fourteen ounces—assays gave gold at the rate of 0.875 of an ounce to the ton of 2,000 pounds; Mackie's mine, south vein, Wawa lake, a single specimen weighing one pound five ounces, was found to contain gold at the rate of 0.175 of an ounce to the ton of 2,000 pounds.

'It is to be remembered that although the samples tested were not Assays not conclusive.
'selected,' the above assays are not to be held as determining the richness or otherwise of the whole vein in any case, but only of the particular specimen tried: still they are interesting as showing that a large proportion of the veins thus tested are, to some extent, auriferous, and that a few of them contain a promising amount of gold, as far as can be judged from a single assay.

'*Iron Pyrites and Copper Pyrites.*—The occurrence of a bed or vein Iron pyrites.
of pyrite at the outlet of Boyer lake has been already described. Mr. Joseph Cozens, O.L.S., informed me that he had examined the deposit of this mineral on the south side of Sayer lake, and that, while it occurs there in considerable quantity, none of it that he saw was sufficiently pure to use in the manufacture of sulphuric acid. A seam of pyrite occurs on the hillside at the head of Little Stony portage, at the outlet of Mattagaming lake, but at the time of our visit, the small opening which had been made upon it was filled with débris. The pyrite here is like that at Boyer lake, and its occurrence may be an indication of the same stratigraphical horizon. Impure pyrite was said to have been found on a hill overlooking Lake Superior, a short distance south of the long sand beach at the mouth of Michipicoten Copper pyrites.
river. In my summary report for 1898, reference was made to the

Ontario. Cont. existence of copper pyrites on one of Johnson's locations on Wawa lake, and also at a placed called 'Frechette's Mine,' about fourteen miles inland to the east of Gargantua harbour, from which we had obtained specimens, but could not find the vein from which they had been derived. Last year this vein was re-discovered, and I was informed it is sufficiently large and rich in copper to be worth a trial. A specimen of the gangue of the vein was among those which the assays above quoted showed to contain a trace of gold.

Surface geology.

'*Surface Geology.*—The evidences of glacial action are strongly marked in all parts of the Michipicoten district. The contours of the hills show that they have been powerfully glaciated, and the surfaces of the solid rocks are grooved and striated almost everywhere that they are exposed. Boulders are plentifully scattered over hill and valley, except on the limited areas where the finer materials of the drift have been washed out and deposited by water. Well marked moraines may be seen in many places. In some localities, immense quantities of boulders, mixed with a small amount of other drift materials, are heaped up into steep and irregular hills in the most tumultuous fashion, and the surface is apparently unchanged since the ancient glaciers left these heaps as we see them at the present day. The woods have been completely burnt off some of these moraines, and they may be studied in all their details. Some of them exhibit the peculiarities of what have been called kettle moraines; that is, they are interrupted with large and deep pits with steep sides, which are supposed to be due to great masses of ice around which the moranic material was piled, and on the melting of the ice the sides of the spaces it occupied were left as steep as the stability of the surrounding material would permit. Examples of such moraines on a large scale may be seen along the north-east side of the Canadian Pacific railway, between Wa-ba-tongwa-sheen lake and Magpie river, especially from Otter station for a few miles northward; again at the south end of Pokay lake on White river, and southward to the extremity of Wi-qué-amika lake, which lies a short distance west of Kapus-ka-sing river, below Chapleau. The general course of the glacial striæ in the interior is toward the south-west, but as we approach the western part of the district they tend more southward, being about south-south-west.

Kettle moraines.

Examples.

Course of glacial striæ.

'The heavy deposits of sand, gravel and shingle of the valley of the Michipicoten below the High falls are cut into many distinct terraces in various parts of their distribution. Above these falls, higher terraces were observed at a few places. Terraces were also seen in the valley of the Magpie, and around the lakes at the head of the Kapus-ka-sing river, south-west of Chapleau. The high terraces to the eastward of the mouth of Dog river are very distinctly seen from the lake, and they form an interesting feature in the landscape. They have been already described by different geologists. It is a fact, worthy of

Terraces.

note that, in some of the larger streams flowing into Lake Superior, the bed becomes paved with almost uniformly sized cobble-stones after descending to a certain level, while this feature is absent in other tributaries. The Black river near Schreiber, the Magpie and the Michipicoten are thus characterized. Ontario—Cont. Cobbles in river beds.

Physical Features, Soil and Timber.—In general physical character, the Michipicoten district may be said to be hilly and rocky, with the valleys pretty well filled with glacial and post-glacial deposits. The height-of-land between Lake Superior and Hudson Bay has an average altitude of about 1,000 feet, wherever it is crossed by the various canoe-routes, but between these depressions the ground rises from one hundred to three and perhaps four hundred feet higher. The washed soil of the modified drift deposits is of a poor quality. Better land is often found on the tops and sides of elevated hills and ridges where the surface has had time to decay and mellow, but it is almost always encumbered with boulders. When cleared of timber, much of the ground will no doubt prove suitable for pasturage in connection with dairy farming. Physical features. Soil.

'In probably the greater part of the district, the woods are still green, although large areas have unfortunately been burnt over near tote-roads, canoe-routes and along the line of the Canadian Pacific railway. The timber everywhere consists of a mixture of coniferous species with the northern deciduous kinds. Small quantities of white and red pine are met with here and there, as the limiting line of these trees passes a little to the north of the sheet, but both species may be considered scarce compared with most of the other trees of the district. South of the Michipicoten river, the rounded hills of a large area, are covered with groves of rather small hard maples; but in the rest of the district, white and black spruce, Banksian or jack pine, tamarac, white birch and aspen are the most abundant trees. They are mixed with a minor quantity of balsam fir, white cedar, rough-barked poplar or balm of Gilead, rowan or mountain ash and bird cherry, while soft maple, black ash and white elm occur locally. I have seen an occasional yellow birch in the lower Michipicoten valley and this tree becomes more common a little further south. Neither hemlock nor red oak range into this district, although they reach to a certain distance up the east shore of Lake Superior.' Burnt woods. Species of trees.

'Before closing this report I wish to acknowledge many courtesies received from the Messrs. Clergue, which facilitated our work during the season, as well as from Professor Willmott, Mr. Lawrence and others working under their instructions. Acknowledgments.

In the spring, arrangements were made with Mr W. A. Parks of Toronto University to undertake geological and surveying work in the Work by Mr. W. A. Parks.

Ontario—*Cont.* Muskoka district of Ontario, with a view to obtaining the information necessary for the Muskoka map-sheet, No. 117 of the Ontario series. Mr. Parks was engaged in this work most of the summer, and has already covered a considerable part of the necessary ground. He reports as follows on the progress of the work :—

'After spending a week in the office of the Survey in preparing plans, procuring supplies and other work incidental to taking the field, I left on June 5th, accompanied by Mr. H. O. McKinnon, who acted as my assistant during the summer. The following day we proceeded by

Starting point rail to Huntsville, where I made up the rest of my party. A day was spent here in getting supplies packed in proper form for transportation by canoe. As soon as possible I moved through Fairy lake and established the first camp at its eastern end. Huntsville was selected as the starting point because it affords ready access to a chain of lakes

Area of Muskoka map-sheet. stretching to the eastern side of the sheet. The Muskoka map-sheet lies approximately between longitudes 78° 53′ and 80° 22′ and latitudes 44° 99′ and 45° 31′. Its western boundary is the shore-line of Georgian Bay. Like the other map-sheets of this part of Ontario, it embraces an area of forty-eight by seventy-two miles. It adjoins the similar Haliburton sheet to the east. Within this district lie the famous Muskoka lakes Muskoka, Joseph and Rosseau, as well as the Lake of Bays resorts, and numerous other places of summer recreation. The Northern division of the Grand Trunk railway crosses the sheet from south to north, entering it near Gravenhurst and leaving in the vicinity of

Joined by Dr. Barlow. Scotia Junction. About a third of the whole area lies to the east of the railway and it was this portion that I endeavoured to cover during the summer.

'On June 7th I was joined by Dr. A. E. Barlow who remained with the party about two weeks. It was deemed advisable to thus associate Dr. Barlow with myself that I might benefit from his experience in the adjoining Haliburton district.

Lakes east of Huntsville. 'The chain of lakes stretching eastward from Huntsville consists of two small bodies of water, Fairy and Peninsula lakes, connected by a short canal, and a larger one known as the Lake of Bays, so called from the numerous indentations in its shore line. This latter lake was, in the early days, called Trading lake from the location of a Hudson's Bay Company's post on a narrow neck towards its eastern end. The part beyond this narrows is still known as Trading lake, at the extremity of which is the village of Dorset and this is as far as our map sheet extends.

'The above mentioned canal affords uninterrupted navigation through Fairy and Peninsula lakes but a portage of sixty chains is necessary to reach the Lake of Bays. The latter lies 101 feet above Peninsula lake.

'The two branches of the Muskoka river, rise in Lake of Bays and Ontario--Co' Fairy lake respectively and form a confluence near Bracebridge. In the vicinity of Huntsville and on Fairy and Peninsula lakes, the rocks consist of more or less horizontal and fine grained gneisses, bent into gentle undulating folds. Petrographically they are highly siliceous and, in many places charged with pink garnets. They appear to be comparable with the sillimanite-garnet-gneiss described by Dr. Adams and referred to the Grenville series. Muskoka river.

'On entering the Lake of Bays, rocks of this nature soon give place to a series of rusty gneisses, which in turn are replaced by the ordinary gray and pink gneisses of the Laurentian, and these constitute the characteristic country-rock of the whole region examined. The strike and dip is quite variable, while evidence of much folding and contortion is presented in many places. Basic and acid bands are found sometimes interlaminated, and in other cases marked off by sharp lines of contact. Veins and masses of injected pegmatite are common, as well as intrusions of various basic rocks. One very interesting example of the latter type is seen in Haystack island in the Lake of Bays. This islet is 'a cone-shaped mass of harzburgite (?) which, however, seems to be of earlier origin than the gneiss surrounding it. Rocks of Lake of Bays.

'Compass and micrometer observations were made to tie in islands not marked on existing plans, and in some cases to correct the shore-line. Surveys of a similar nature were conducted over most of the roads accessible from the water and canoe trips were made, where possible, into the neighbouring small lakes. This and the work of collecting specimens occupied the time until July 2nd when the camp was moved back past Huntsville to Lake Vernon, where the heavier part of the equipment was stored, preparatory to a trip up the East river which is really the upper water of the north branch of the Muskoka river. This expedition occupied us about two weeks. The river was ascended with considerable difficulty as far as the crossing of the old Sinclair road, from which point we portaged into Bella lake and remained in camp there while the shore-line was examined and surveys made of the roads to connect with those previously extended northwards from the lakes. A good deal of pine is driven down the East river every spring but it comes from the district to the north-east. The country is, however, well wooded with beech, maple, hemlock and birch, most of the pine having long since been removed. The soil is practically all sand. Farms are somewhat widely separated and I regret to say that here, as elsewhere in the region, abandoned homesteads are too much in evidence. Nature of surveys made. Expedition up East river. Timber.

'The East river is very crooked and its upper part a succession of shallow rapids.

Ontario Cont.

'On July 17th I proceeded down the north branch of Muskoka river from Fairy lake. At the outlet is a fall of eight or ten feet with a dam and lock to permit small steamers to pass down to Port Sydney at the foot of Marion lake. This lake is a pretty body of water studded with islands of a rocky nature, which character is also presented by the shore, particularly on the western side.

Soil.

'Sandy soil predominates, but stratified clay underlies it in places; no boulder-clay was observed anywhere in the region. The rocks are more or less horizontal in position, but average N. 20°—40° W. in strike.

'At Port Sydney the river breaks out of Marion lake and falls about twelve feet. The canoe navigation is excellent, for although there is a heavy fall in all, the descent is confined to short distances, finding its expression in three or four high falls. This is brought about by two circumstances; first, the course of the river is against the dip, and second, the presence of large masses of pegmatite.

'A micrometer re-survey of the river was carried to Bracebridge, in the course of which halts were made for the purpose of traversing the adjacent roads for topographical and geological purposes. Bracebridge was reached on July 24th. The camp remained near this place for nearly a week while the roads to the north, south and east were surveyed. Some fair farm land is encountered in the first two directions and eastward also near Bracebridge, but towards the limits of the townships of Draper and Macaulay in that direction, particularly in concessions II and III of the latter township, the land is exceedingly rough, rocky and barren.

Existing surveys inaccurate.

'In order to ascertain the correctness of existing surveys of Muskoka lake, a traverse was run from the mouth of the river to Gravenhurst. The shore-line is not well defined on old maps and very great inaccuracies exist regarding the islands. My observations were supplemented by the experience of those residing in the region, by whom a wish was expressed for more correct plans. The gneissoid rocks on the east shore of the lake are somewhat different from those previously met with, but I must await microscopic examination before entering into details respecting these.

South-east part difficult of access.

'On August 1st we arrived at Gravenhurst and proceeded to examine the adjacent roads; two of these were surveyed to Bracebridge, and the old Muskoka road was traced south and tied to Kah-kah-she-bog-a-mog lake. Though a survey was not made farther south, as it lies beyond the sheet, I examined this road into Severn Bridge. The south-east part of the sheet, including the township of Longford and part of Oakley and Ryde, is difficult of access by water. To examine this I stored my heavier baggage and canoes at Gravenhurst and

engaged a man and team. As I had been obliged to part with one of my men, the party still numbered five.

Ontario.

'We proceeded by a road running eastward from the old Muskoka road about three miles north of Gravenhurst. This was surveyed to its junction with the Black River road from Orillia, a few miles south of Houseys rapids. A stay of several days was made at this point and traverses made to the east and south, as also a complete plan of Kah-kah-she-bog-amog lake, which took several days. This lake is about six miles long, very crooked and full of islands, few of which had been located by previous surveys.

Kah-kah-she-bog-amog lake.

'From the junction of the above-mentioned road with the Black River road, the latter was surveyed to Victoria bridge. It follows the river on its northern bank and is rather rough in places. The farms however, are of a better appearance than in many other parts of the region. To the eastward, beyond the bridge, is a very desolate, burnt, rocky tract of country known as "the plains." The East River road crosses to the south side of the river at the bridge and has not been used beyond this point for some time. A few miles up it crosses the south branch at the fork, where the two upper streams unite to form the main river.

Black River road to Victoria bridge.

'While camped at Victoria bridge, the side line 5—6 Ryde, was surveyed to connect with roads previously examined to the north. We remained at the forks for a few days while a canoe expedition was made to Bear lake, and other small bodies of water up the south branch. This region is largely burnt; the fire having extended from the plains and swept the southern part of the township of Longford almost to its eastern boundary. Several varieties of gneiss were noted on this trip.

Trip to Bear lake.

'From the forks I directed Mr. McKinnon to continue the traverse of the road through the township of Longford, which he did, and reported green bush, chiefly hardwood and hemlock, all the way. In the meantime I went up the Black river by canoe, portaging into North and South Longford lakes on the way, and joined the party on the road following the town line of Longford and Oakley. On this trip the river was found to be very shallow, with a good current and sandy bottom; green hardwood timber and sandy soil prevailed all through the township. No farms are cleared in Longford, as the township is the property of the Longford Lumber Co., and is not open for settlement. From this point Mr. McKinnon continued the traverse of the road back to Gravenhurst, while with one man, in the small bark canoe, I endeavored to ascend the river to Black lake. After one day's work the stream was found to be so exceedingly shallow that I disposed of the canoe and proceeded by road through Oakley

Examine Black river.

Ontario—Cont. and Ridout to Dorset. There are no settlements, and the road has been used for lumbering purposes only, being now badly out of repair. Some splendid beech and maple were noted on this trip.

Jom party at Gravenhurst.

'On arriving at Gravenhurst I found the party camped on Gull lake and we made a survey of that water as it appears very inaccurate on old maps. The party was now reduced to three. On August 24th, we left Gravenhurst and paddled up the lake to Bracebridge, camping that night at the South falls on the south branch of the Muskoka river. The micrometer survey of this stream was tied to the railway bridge at Bracebridge and continued to the source of the river at Baysville, at the foot of the south arm of the Lake of Bays. This stream proved very useful, as it enabled us to connect the road surveys to the north with those to the south. It is more crooked and there are more portages than on the north branch. Except for several basic and pegmatitic bands the rocks are gneiss as elsewere. Some very good farms are seen at various points in this region.

'On September 8th, we reached Huntsville and here I broke camp shipping my canoes to Gravenhurst to be ready for next season's work.

'There still remained a portion of the territory on the northern limit of the sheet. To reach this I went by rail to Emsdale and remained with Mr. McKinnon at the hotel there while we examined the roads accessible from that point, this concluding the field-work for the season.

Economic minerals.

'With regard to the economic minerals of the region examined, there does not seem to be a promising outlook, despite the fact that numerous prospects have been opened. Nearly all of these are on veins of pegmatite containing specks of both copper- and iron-pyrites. Some others are in the gneiss itself on mineralized bands. A few stringers of quartz were noticed, but both the nature of the quartz and its manner of occurrence would not indicate an auriferous deposit. Some of the pegmatites contain leaves of both white and black mica that may prove valuable, as I have encountered similar deposits of value just outside the limits of the sheet. A small deposit of crystalline limestone was seen east of the railway in the township of McMurrich.'

Petrographical work by Drs. Barlow and Adams.

In the first part of the year, or up to the beginning of May, Dr. A. E. Barlow was absent in Montreal engaged in conjunction with Dr. F. D. Adams, in detailed petrographical studies of the more important rock types represented in the area of the Haliburton map-sheet. Advantage was thus taken of the unusual facilities offered for this work by the new Petrographical Laboratory in the Chemistry and Mining Building of McGill University. It was also believed to be important that the joint report now being written by these gentlemen

should have the advantage of the closest co operation before the final results were given to the public. Ontario—*Cont.*

This work being completed Dr. Barlow returned to Ottawa on May 1st and assumed the duties of petrographer, which position had remained vacant since the resignation of Mr. W. F. Ferrier in 1897. Some weeks were spent in the office on work incidental to this position, as well as in the compilation of the results obtained by the special examinations above referred to. In regard to the field work undertaken, Dr. Barlow reports as follows :— Duties of petrographer assumed.

'I left Ottawa on June 5th for the Muskoka district, going by way of Toronto, for the purpose of examining the various plans of surveys made in this area by the Crown Lands Department of Ontario. Two days were occupied in collecting this and other information relative to the district in question, when I left for Huntsville to join Mr. W. A. Parks of Toronto University. Mr. Parks had been instructed to undertake the topographical and geological surveys necessary for the preparation of a map and report of the area covered by the Muskoka map-sheet (No. 117 Ontario series). Two weeks were spent in company with Mr. Parks, and the work then accomplished consisted of various topographical and geological surveys in the region adjoining Fairy and Peninsula lakes and Lake of Bays between Huntsville and Dorset, connection being made at the latter point with the work already completed on the Haliburton map-sheet. Field-work by Dr. Barlow and Mr. W. A. Parks.

'Returning to Ottawa on June 24th, some days were occupied in examining and reporting on specimens of rocks from various localities. On July 5 I again left Ottawa for Barrys Bay, to make a more detailed examination and study of certain localities in the Haliburton district. I was accompanied on this trip by Prof. H. P. Cushing of Adelbert College, Cleveland, Ohio, who is at present engaged for the New York State government in a geological survey of a portion of the Adirondack mountains, and who wished to visit this district for purposes of comparison and study. Numerous interesting geological exposures were visited, for the purpose especially of noting the various phases of alteration represented by the rocks that have been referred to the Grenville and Hastings series and the nature of their junction with the granites and gneisses usually classified as Laurentian. Haliburton district.

'A visit was paid to the corundum mines situated on what has been known as the Robitlard Property but which is now called the Craig mine, so named in honour of the energetic vice-president and managing director of the Canada Corundum Company, Mr. B. A. C. Craig of Toronto. This company, with a head office in Toronto, and branch offices at Bridgeport, Conn., and Combermere, Ont. is now energetically carrying on the mining and subsequent treatment of this abrasive Corundum.

Ontario--*Cont.*

on lots 3 and 4 in concession XVII of Raglan. A mill operated both by steam and water power has been built in a very suitable location and fitted up with the latest machinery for the crushing and separating of this mineral. During the whole of the past summer the equipping and necessary experimenting has been going on steadily and it is confidently believed that large and regular shipments of the very purest material will soon be made. The mining already done has shown conclusively that the deposit is very rich and extensive, so that there is no likelihood of the supply giving out.

Mill in operation.

Iron.

'Visits were also made to some of the localities where openings had been made for iron, especially in the vicinity of Bancroft and along the line of the Irondale, Bancroft and Ottawa railway in the townships of Snowdon and Glamorgan. It would be inadvisable at this time to go into details regarding these various mines and the mode of occurrence of the iron ore, as it is better that this should be postponed until a fuller examination can be undertaken of the various specimens collected. Two openings for iron have lately been made in the vicinity of Bancroft on lots belonging to Mr. J. Cleak. One of these, situated a short distance southeast of this village, about lot 30, concession XIII. of Dungannon, shows a very pure magnetite occurring as a differentiation product of the nepheline syenite. The deposit is, as might be expected, very irregular, and it is doubtful whether any very large amount of the mineral could be secured. Large, though somewhat imperfect octahedrons occur as cleavable masses of magnetite frequently containing comparatively large individuals of apatite. The other opening is about half a mile southwest of the village, in the township of Faraday. Too little development work has, however, been done at this locality to make any definite statement as to its character or extent.

Development work.

Mode of occurrence.

Howland mine.

'Along the line of the Irondale Bancroft and Ottawa railway, perhaps the greatest amount of work has been done on what is known as the Howland mine, belonging to Mr. H. S. Howland, of Toronto, and leased to the Toronto Iron Company. The ore is a magnetite with a considerable admixture of pyrite, which latter mineral is probably so abundant as to render the ore practically useless. About 1,500 tons of ore were shipped from this mine in 1881 and 1882, chiefly to the Cambria Iron Company. Last year the mine was pumped out with the idea of carrying on further work, but so far nothing further has been done.

Imperial mine.

'A considerable amount of ore has likewise been taken from the property known as the Imperial mine, owned by Mr. S. B. Howland, of Toronto. This is on lot 33, concession V, of Snowdon, about three-quarters of a mile east of Irondale station and immediately adjoining the right of way of the Irondale, Bancroft and Ottawa railway. Most

of the mine, so-called, consisted of a basic rock, portions of which occasionally become so richly impregnated as to constitute what might be considered a low grade iron ore. In the vicinity of Furnace Falls a large expenditure has been made but evidently failed to secure such adequate returns as would justify continued operations. These properties were at first known as the Snowdon mine, but are now called the Victoria mine. There are undoubtedly considerable areas of richly impregnated basic rocks, but the large percentage of sulphur usually present seems to be the main drawback. Another very interesting locality is what has been called the Pine Lake mine or location on lot 35 in concession IV. of Glamorgan. The iron ore at this place likewise occurs in association with a basic rock which is a differentiation product of the nepheline-syenite of which there is a considerable area in the vicinity. It is said to contain about nine per cent. of titanium and is thus practically valueless. Ontario--*Cont.* Other mines

From August 5th to August 20th, I was engaged in co-operation with Mr. James White in a transit and chain survey of the Canada Atlantic railway from Rose Point to Scotia Junction, and also of the Northern Division of the Grand Trunk railway from Scotia Junction to Atherley Junction, where connection was made with similar surveys performed in previous years. This survey was undertaken for the purpose of fixing with greater accuracy the position of the Muskoka map-sheet. Joint work with Mr. James White.

Returning to Ottawa on August 25th, the remainder of the year has been taken up in special rock determinations.'

ONTARIO.

(With adjacent parts of Quebec.)

The winter of 1899-1900 was spent by Dr. R. W. Ells in compiling map-sheet No. 120, and in writing a report on the work done in connection with map-sheet No. 119. The field-work of the past season covered various localities in Quebec and Ontario from about eighty miles east of Ottawa to a similar distance west of the city. Dr. Ells' report is as follows :— Work by Dr. R. W. Ells.

'Towards the end of May examinations were made of certain points of geological structure in the townships of Russell and Osgoode, in connection with the delimitation of the Rigaud-Russell fault and anticline. The surveys of the township of Russell were also completed.

'Early in June work was continued in the area south of the Ottawa river, in mapping out the faulted area, in order to determine the boundaries of several outliers the Utica shale which had been reported as occurring in that district. The presence of several low but well defined anticlines in the underlying Trenton limestone was South of the Ottawa.

Ontario and Quebec Con.

also ascertained. These anticlines separate the shallow basins of the Utica, and the latter were outlined as well as the drift-covered nature of the area permitted.

'Farther east, in the vicinity of Rigaud mountain, surveys were made to the south and west, to complete those made by the late Mr. Giroux, in 1895. In this connection, a secondary spur of granite which lies to the southeast of the main mass of Rigaud mountain, was outlined and found to be about three and a half miles in length with a breadth in the centre of the mass of about half a mile. It is separated from the main mountain by a depression which is about half a mile in width at the nearest point and extends roughly parallel to the southeast face of the mountain itself. This second ridge is crossed by the road east from Ste. Marthe village, and large areas of sand cover the surface of the country to the north and east in the direction of the Ottawa, while to the south the country is a great level expanse of clay, reaching to the St. Lawrence.

Granite south of Rigaud mountain.

'This area south of Rigaud mountain rarely shows rock exposures, but is supposed to be underlain by the Calciferous formation, since the limestones of this formation are seen on the Rivière à la Graisse at Rigaud village and on the same stream four miles west of that place where the strata dip S. 10° to 18° W. <5° to 7°.

Rocks of Rigaud mountain.

'The material of Rigaud mountain is largely a reddish quartz-porphry. On the eastern end, however, there is a large mass of hornblende-syenite of a reddish or purplish gray colour, in which a quarry has been opened, and from which large blocks have been taken for monumental work.

Work north of the Ottawa.

'In July, several weeks were given to the completion of the surveys in the area north of the Ottawa and west of the Gatineau river. The work in this part of the province of Quebec is now practically completed and the map is being compiled.

Survey of Ottawa river.

'Along the Ottawa river, west of Ottawa an examination was made of the south shore, in order to define the limits and possible thickness of the Calciferous, Chazy and Trenton in this direction. It was found that no measurement could be made of the Trenton, as only the lowest beds of the formation are seen in this area. The thickness of the Chazy shales, to the base of the Chazy limestones, is a little over 100 feet, on the south side of the river, but the base of the formation is not there seen.

Surveys in Raglan and Lyndoch.

'Later in the season, surveys were made in the townships of Raglan and Lyndoch in the western part of map-sheet No. 119, which is contiguous on the west to that now being prepared for publication by Drs. Barlow and Adams.

'In the latter part of July and in August, new work was taken up on what is known as the Brockville map-sheet, No. 111. The portion of this sheet in Canada is limited, embracing not more than 400 square miles, bounded on the south by the St. Lawrence river. The eastern limit of the map-sheet on this river is a short distance below the town of Prescott, where it joins map-sheet No. 120, while the western limit is near the east line of the township of Lansdowne.

Ont. [illegible] Cont. W[illegible] the Brockville sheet.

'In September, a few days were spent in the vicinity of L'Orignal and Hawkesbury with Dr. Ami, to determine more precisely the horizons of certain limestones of Chazy, Black River and Trenton age. The last days of field work were devoted to completing details relative to the map of Ottawa and vicinity, now nearly ready for the engraver.

'In regard to the work in the area along the south side of the Ottawa river, the principal geological features have already been stated in previous Summary Reports. The outlining of the basins of the Utica shale formation is a somewhat important feature, however, in connection with work now being carried on by boring to ascertain the presence or otherwise, of natural gas or oil in this district.

Utica shale [illegible].

'The presence of these rocks was first indicated by Mr. James Richardson in 1853, but no attempt was made to determine their precise limits at that date. This is difficult, owing to the great development of clays and overlying sands throughout a large part of the area. From careful observation, however, it is established that at least two well defined areas of the Utica extend in a northwest direction from the great area of these rocks in the southern part of the townships of Russell, Plantagenet and Clarence.

'Of these the most westerly extends in a narrow belt from the vicinity of the village of Caron into the township of Cumberland which continues as far west as the fourth lot of the third range of that township and may extend farther, as rock outcrops in this direction are here concealed by a heavy mantle of clay. The upper portion of the Trenton formation is seen on the north and south sides of a depression in which the Utica shales lie. The exposed breadth of the Utica at this place is about sixty chains. Continuous outcrops of the shales are rarely seen for any distance, though the character of the soil sometimes indicates the nature of the underlying rocks, and it would seem from the presence of a well-defined area of flat country, heavily clay covered, that the Utica of this narrow basin is fairly continuous.

Distribution of formations south and east of Ottawa.

'East of the village of Caron, these rocks are seen in the depression west of the Nation river along what is known as the brook; and the northern limit of the main area passes near the village of Pendleton. Thence it apparently continues along the north side of the Nation

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river where it is reached by a bore hole 180 feet deep through clay, on lot six, range eleven, of South Plantagenet.

'The northern line of the Utica thence apparently bends to the north and north-west, and follows a depression which is seen a short distance east of the village of Curran, whence the Utica shales should extend in a narrow belt past Plantagenet springs. The shales themselves are seen as far north in the course of this depression as the line between concessions two and three of Plantagenet north, on lots thirteen and fourteen, where they terminate against the Trenton limestone.

South Nation river.

'Along the South Nation river, the Black River limestone is well seen at the little fall, about one mile and a half from the junction of this stream with the Ottawa. The strata here dip to the south-west, but bend abruptly to the south showing a somewhat sharp anticline. These rocks are overlain up stream by the Trenton limestones, which are well exposed at several points, notably at and above the village of Plantagenet where they have a southerly dip at angles of five to ten degrees, and where they undoubtedly pass beneath the Utica just described. It would appear that the line between the Trenton and the Utica crosses the Nation river and reaches the township of Alfred near the line between concessions nine and ten, where the black shales have been struck by a boring through the clay of 186 feet in depth, a few yards east of the western line of the township of Alfred. A heavy discharge of gas and saline water is said to have taken place when the Utica shale was reached. Saline water is still flowing from the hole, and this is valued in the neighbourhood for its medicinal properties.

Borings for gas and water.

Utica shale areas.

'The Utica shales thence cross the southern part of Alfred township and extend beneath the Caledonia flats into the township of Caledonia where they are well seen at a number of points resting on the Trenton to the south-west of Vankleek Hill.

The two areas of the Utica shale just described are separated by well defined ridges of Trenton limestone. At several points, opposing dips to the north and south at low angles are visible, indicating an anticlinal structure which is presumably continuous throughout, though lack of exposures prevents the tracing of the anticlines to any very great distance. The main area of the Utica extends southward through the southern part of the townships of Cumberland and Russell till it meets the line of the great fault along the Castor river, which is well seen in the village of Russell and for a mile east of that place.

'Throughout the area just described minerals of economic value are rare. The limestones afford good quarries at a number of points, and these have been opened for building-stone. The largest and presu-

mably the most important of these is near Rockland, known as the Stewart quarry. It is situated on the north face of a steep escarpment of limestone, the lower part of which consists of Chazy and Black River strata while the upper portion of the quarry is in the Trenton limestone. Lime of an excellent quality is also burnt here. Ontario and Quebec—*Cont.*

'Among other quarries in the Trenton limestone may be mentioned one on lot eighteen, concession seven, of Clarence, owned by Mr. John Maclean, and situated in the upper part of the formation, the Utica being exposed on the adjacent lot. There is also a quarry near the top of the Trenton owned by Mr. Percival Whinney and situated on lot nine, concession six, of Plantagenet north. This is but a short distance from the line of the Canadian Pacific railway. Another quarry, but in the Black River limestone, is located near the church at Clarence Creek, where the beds dip north-east at angles of from ten to twenty degrees. Limestone quarries.

'A number of bore-holes have been made throughout the area between the Ottawa and the South Nation rivers within the last half-dozen years. These have in most cases been sunk only through the clay in which, however, are occasional thin layers of gravel and sand. The thickness of the clay covering is in many places remarkable, many of the holes having a depth of from 100 to 150 feet, while in one case a depth of clay of 210 feet was passed through before the underlying rock was struck. Borings in valley of Nation river

'While most of these holes were sunk in the search for water, in a number of them flows of gas were encountered. The most noted of these holes is that already referred to as on the bank of the Nation river. This was sunk by Mr. Gordon, and the Utica shale was penetrated to a depth of only three inches. The rush of gas and water is reported to have been very heavy. The gas subsequently ignited and the farm buildings were removed to prevent their destruction. The pipe was taken from the hole and the water (saline) now flows in a good-sized stream from a square opening about four feet across, the surface of the water being broken by a constant discharge of gas bubbles which can be ignited as they emerge. Similar outflows of gas and water were met with at the boring in Alfred, which is two miles and a quarter distant in a direction nearly east. Gas found.

'The presence of several important faults in the area south of the Ottawa river has already been pointed out. In addition to those noted in the report of last year, there is an apparent dislocation of the strata on the Montreal road about a mile and a half west of the crossing of Greens' creek, which throws the Utica shales to the north. Nearer Ottawa city, it is clear that the fault noted on the shore of the river at Governor's Bay is continuous with that seen near the entrance to Beech- Fault near Ottawa.

Ontario and Quebec—*Cont.*

wood cemetery, where the Chazy is brought against the Utica shales for a short distance. Minor dislocations are seen in the Utica itself, as in the drainage excavation on the old Rifle Range near the crossing of Chapel street, and also in the creek a short distance south of Billings Bridge. These minor breaks are numerous throughout the area, and prevent the exact determination of the thickness of the Trenton and Utica formations.

Iron-pyrites in Masham.

'In the area west of the Gatineau, several new mining locations were visited. Among these may be mentioned a reported large deposit of iron pyrites in Masham, lot fourteen, range five, owned by Mr. R. Kennedy. But little development work had been done when I was there, but there appears to be a rather large development of pyrite in the so-called rusty gneiss that is so frequent a feature in the rocks of the Grenville series. The pyrite does not, in so far as yet proved, seem to be sufficiently concentrated for profitable mining. The locality is about four miles from the line of the Gatineau Valley railway at North Wakefield.

Mica mines.

'The mica mines along the Gatineau are being worked with more or less regularity, but the output varies greatly from time to time, owing to the pockety character of many of the deposits. Among new locations noted during the past season were several in the township of Cawood and in Alleyn near by. Of these the most important was on lot ten, range one, Alleyn, owned by Mr. Ellard. The country-rocks at the mine are grayish gneiss and some limestone, cut by a dyke of green pyroxene. The mica vein appears to have a thickness of two to three feet, and at the time of my visit, in July, had reached a depth in the excavation of forty feet. The crystals of mica were of good size and colour and nearly 200 tons of mica were in the sheds. From twelve to fourteen men were employed. The mine is about seven miles from Kazabazua station on the Gatineau Valley railway.

'At the other mines near Dunford lake, but little work was being done. A dyke of pyroxene was noted here also and some large mica crystals had been obtained, but in the lower part of workings the crystals were much crushed.

Granitic rocks in Brockville district.

'In the area comprised in the Brockville sheet, some important geological features were noted. The eastern portion of the district is occupied by rocks of Calciferous and Potsdam age, while the western part of the area shows great masses of reddish granite, gneiss and crystalline limestone, with large outcrops of glassy white quartzite.

'The granitic rocks form most of the islands in the River St. Lawrence, known as the Thousand Islands. The granites are clearly of more recent date than the limestones and quartzites, with which they are associated. They present the same character as most of

the rocks seen along the north side of the Ottawa, except that the granites are more extensively developed in the St. Lawrence district. The quartzite is like that seen in the Ottawa river section, opposite Montebello, where this rock is clearly an interstratified member of a series between the grayish and reddish gneiss and the crystalline limestone with rusty gneiss inclusions. They are also identical in character with parts of the Hastings series to the west, much of the limestone seen about Charleston lake and in the township of Lansdowne having the same banded or striped aspect with that of the Arnprior and Renfrew marbles. Ontario and Quebec—cont. Crystalline limestone and quartzite.

'Overlying these crystalline rocks are the Potsdam sandstones. The basal beds of this formation frequently consist of conglomerates, in which the greater part of the pebbles are derived from the quartzites just described. The conglomerates pass upward into the regular sandstone, which, in turn, graduates upward into the limestone of the Calciferous formation. Potsdam sandstones.

'While fossils are seen at several points in the limestones of the Calciferous formation, none were found in the sandstones of the Potsdam proper, except those known as Scolithus markings. The fossils referred to in the earlier reports as being obtained from beds of Potsdam age, were found in what are known as the transition beds between the sandstone and the limestone. They are here frequently silicified and can sometimes be readily extracted, the best being obtained from weathered surfaces of a siliceous limestone which represents the base of the Calciferous formation. Fossils.

'This area north of the St. Lawrence was one of the first explored by the officers of the Geological Survey. In 1851, Mr. A. Murray spent a considerable portion of the summer in the examination of the district between the Rideau and the St. Lawrence, the results of which are found in the report of the Geological Survey for 1851-52. In this report the characters of the several formations of granites, limestones and Silurian rocks are well given. Former work by Alex. Murray.

'The outline of the crystalline area north of the St. Lawrence above Brockville is very irregular. The rocks consist largely of granites, mostly red in colour, generally massive, but occasionally foliated. In places, small areas of grayish and reddish gneiss occur, and there are frequently large exposures of quartzite, more especially along that part of the river in the southern portion of the township of Escott and of Lansdowne adjacent on the west. The quartzite is also seen on several of the islands in the river, notably above the village of Rockport, where it is sometimes associated with grayish gneiss, but more frequently involved with masses of reddish granite. Rocks of crystalline area.

Ontario and Quebec—Conc.

'The beautiful sheet of water known as Charleston lake is situated in the northern part of the townships of Escott and Lansdowne, and is a great place of summer resort. It is crossed by the western line of the Brockville map-sheet, and is very irregular in outline with long arm-like bays and many islands. On the east side, a bold hill known as Blue mountain, rises to an elevation of 360 feet above the lake shore. Its rocks are of various kinds. Red granite predominates, but there are several well defined bands of crystalline limestone and associated rusty gneiss. Areas of the glassy quartzite are seen on several of the islands. These are frequently overlain by the basal or conglomerate beds of the Potsdam sandstone formation, the latter sometimes being inclined at quite a high angle. Masses of granite cut the gneiss, limestone and quartzite. The limestone is frequently serpentinous, with small threads of chrysotile. The rock is often much broken up and the disturbing action of the granites is very apparent.

Charleston lake.

Rocks chiefly granite.

'A long tongue of the red granite extends eastward from Charleston lake through the township of Yonge and forms a ridge to the north of McIntosh's mill and Graham lake, occupying parts of concessions five and six. In the eastern part of this ridge the granite is associated with considerable masses of quartzite, the latter being broken up and penetrated in all directions by the granite. The quartzite furnishes pebbles to the lowest member of the Potsdam, which surrounds the old ridge on all sides. This granite is mostly of the massive variety, though sometimes a foliated structure is visible, and occasionally masses of the grayish gneiss appear to be caught in the granite mass.

Palæozoic areas well-defined.

'Of the two Palæozoic formations represented in this area, viz., the Potsdam sandstone and the Calciferous limestone, the boundaries have been well defined. In some places this has been somewhat difficult, owing to the varying thickness of the transition beds. The line between the two formations has a somewhat sinuous character, being affected by the inequalities of the surface, since throughout most of the area the strata are in a nearly horizontal position. A small outcrop of the granite and gneiss, surrounded by the Calciferous, is seen on the road between lots six and seven, range seven of Elizabethtown. This is the most easterly outcrop of these rocks yet recognized.

'The Potsdam often lies in small detached basins upon the crystalline rocks, but in the area west of Brockville it sometimes takes the form of long tongue-like troughs which occupy depressions in the underlying granite and quartzite. One of the most marked of these extends south-west from Escott into the township of Lansdowne, with a length of about ten miles and a breadth ranging from a mile to only twenty chains. Near the village of Lansdowne this outcrop is concealed by overlying clay and sands.

Ontario and Quebec—*Cont.*

'The line between the Potsdam and Calciferous on the St. Lawrence, is seen near the village of Maitland, which is about five miles east of Brockville. The contact of the Potsdam with the crystalline rocks, quartzite and granite, is in the city of Brockville itself, the former showing along the shore in its eastern part, while the quartzite is seen in the ridge on which the town is built. The islands in the vicinity are also of crystalline rocks apparently. Above this place the granites extend for about four miles along the shore, and occupy the islands in the river for that distance. Then the Potsdam sandstone comes in along the shore and forms an overlying mass which extends upwards for nearly six miles, and thence westward along the line between the first concession and the Shore Range in the direction of Mallorytown for two miles further.

Contact of Potsdam with crystalline rocks.

Thickness of Calciferous not estimated.

'The Calciferous formation, which is essentially a dolomitic limestone throughout, except in its upper part, which becomes somewhat shaly, occupies the greater part of the townships of Augusta, Elizabethtown, the north-west part of Yonge, almost the whole of Kitley, and a portion of Bastard. The surface in this district frequently shows large areas of bare rock and many of the roads are in consequence hard and rough. No estimate was made of the thickness of the formations, but it is the western extension of the great Calciferous area which appears in the townships of Gloucester and Nepean, south of the Ottawa.

Glacial striæ.

'Glacial striæ were observed at several points. The direction varied only ten degrees throughout the district, ranging from S. 15° to 25° W. (ast.) No marine shells were noted in the clays or gravels of this area, though these are continued westward without apparent break from the localities north of Prescott, where these fossils are so abundant.

Economic minerals.

'Eccnomic minerals are rarely found in workable quantity in the area comprised in the Brockville sheet. The iron-pyrites mine on lot nineteen of the second range of Elzabethtown, was the most important in the district during the time of its working. Unfortunately the deposit apparently became exhausted some years ago, and the extensive plant for the manufacture of acids and superphosphate has been destroyed. The process of manufacture of these substances and also the mineral contents of the vein have been fully described in the Report of the Geological Survey for 1874-75, by Dr. Harrington. Attention was directed to these deposits in 1862 by Mr. T. Macfarlane with reference to the presence of cobalt in the pyrites. Recently, new deposits have been found on the adjoining lot, owned by Mr. Nicholas Sloan, and several shallow pits have been sunk on the mineral to test the quantity. The new location is, apparently, on the strike of that formerly worked, and the character of the mineral is similar. The

Cobalt and pyrites.

Copper-pyrites.

pyrites appear to form contact deposits near the junction of the granite and the white quartzite.

'No deposits of magnetic iron of economic importance have been found in this area. Mr. Murray, in his report for 1852, mentions the presence of small strings of the ore on the seventh lot of the second concession of Escott, mixed with small specks of copper-pyrites, the whole occupying a length of about fifty yards with a maximum breadth of six to seven inches.

Red hæmatite.

'Red hæmatite occurs at a number of places in the lowest beds of the Potsdam formation, and is readily recognized by the colour imparted to the soil. The most important deposit of this ore seen was near the village of Delta, in the township of Bastard, on lot twenty-three, concession ten. A small excavation was made on the deposit, which is in the basal beds of the Potsdam sandstone, resting upon crystalline limestones and gneiss, which show in the immediate vicinity. The ores of this locality were mined nearly one hundred years ago, and smelted in a blast furnace at what was then known as Furnace Falls, now Lyndhurst, but the quantity obtainable was not sufficient to supply the demands of the smelter, and the works have long been closed.

Bog iron ore.

'A bed of bog-iron ore was also noted by Mr. Murray on the twenty-first lot of the seventh concession of Bastard, which had a reported thickness of two feet in one place, but the extent of the deposit was not ascertained.

Galena.

'Galena has been mined in the township of Lansdowne. The ore occurs in connection with the crystalline limestones of the district. These form somewhat extensive bands, extending across the township to Charleston lake. They are cut by masses of red granite and also by dykes of white pegmatite. The galena veins are small and are in proximity to the dykes. The principal deposits are on lots four and six, concession eight of this township, but no mining has been attempted for some years.

Barium sulphate.

Barium sulphate is found on the twenty-fourth lot of the tenth concession of Bastard. It is of good quality and the amount appears to be considerable, as the deposit extends for at least a fourth of a mile, with a thickness of from one to two feet. This was mined to some extent about fifty years ago. The small value of the mineral is against its profitable exploitation.

Shell marl.

'A deposit of shell marl was found some years ago, in the vicinity of Farmersville, now the village of Athens, on the thirteenth lot of the eighth concession of Yonge. It is said to have a depth of fifteen feet in places, and to extend over twenty to twenty-five acres. It may be

of value in connection with the manufacture of cement, but the deposit has apparently never been developed. Ontario and Quebec *Cont.*

'Among other materials may be mentioned the quartzites along the St. Lawrence and on Charleson lake, some of which appear to be sufficiently free from iron to render them suitable for glass making. Some of the granite masses also should furnish an excellent quality of building stone, since the rock is of good colour and in large massive ledges. Quarries were opened in certain beds of the Calciferous, north of the St. Lawrence, many years ago, but these have not been worked for a long time. The quartzite forms an excellent material for road metal, breaking readily and in such shape as to pack solidly on the street, while the supply is unlimited. Quartzite.

'Field work began on May 27th, and extended to October 1st.

QUEBEC.

Dr. F. D. Adams, who has for some years been collecting and studying the records and drillings obtained from numerous bore-holes sunk in and near the city of Montreal, lately offered to put his results into the form of a report for publication by the Survey, if a geological map showing the surface distribution of the rocks in the vicinity could be provided. The Island of Montreal came under the observation of the officers of the Geological Survey many years ago, but no attempt was made to map the several formations with any minute accuracy. Arrangements were therefore made with Mr. O. E. LeRoy, under which he spent a considerable time, last summer, in a careful survey of all the outcrops within a radius of about ten miles of Montreal. This work it is hoped to continue until it may be possible to complete a good geological map of Montreal and its vicinity. This will have important bearings on the water supply from bore holes, as well as open many other practical questions. Mr. Le Roy describes the work done by him as below :— Offer of report by Dr. Adams. Work by Mr. O. E. LeRoy.

'The object of my work, as stated in your instructions, was to revise the geology of that part of the Island of Montreal and Ile Jesu included within a ten mile radius of Mount Royal. I commenced work on August 13th, and continued it without interruption until September 22nd. Object of work.

'Nearly all the outcrops of rock were examined, specimens taken, and when deemed necessary, collections of fossil were made, which were sent to the Survey for identification. The strata everywhere are almost flat-lying, the dip, with the exception of a few small areas in the vicinity of the mountain, never exceeding 5°. The whole country is so uniformly covered with drift deposits that the boundaries of the different formations must, for the most part, be approximate.

Quebec—*Cont.*

'The formations examined and outlined were as follows, in ascending series : Chazy, Trenton, Utica and St. Helens Island breccia.

Formations outlined.

'The Chazy is well exposed at Cartierville in a series of old and new quarries, and again at St. Laurent near the railway track. From these it continues eastward to Outremont, a small and very fossiliferous outcrop occurring at the corner of Wiseman and VanHorne avenues. The formation then runs north to Mile End (Parc St. Denis) where it has been quarried for many years. Its northward extension terminates on lot 481 Côte St. Michel Sud, from which point it follows a curving line to the north-west, being exposed for some distance along the railway track at Sault au Recollet. Crossing the Rivière des Prairies, it is well developed and extensively quarried just to the north of St. Martin Junction, where it occurs in the form of a rather prominent ridge.

Mount Royal surrounded by Trenton.

'The Trenton formation was first found in a small outcrop on lots 45 and 47 Côte Ste Geneviève. The rock does not re-appear until the vicinity of Mount Royal is reached, which it wholly surrounds. Northward from the mountain, it is well exposed at many points on that part of the island sloping towards the St. Lawrence river, the strata dipping at 4° to the S.E. It curves around the Chazy formation in Côte St. Michel, and is well exposed on both sides of Rivière des Prairies, below Ile Visitation extending as far north on the western shore as St. Vincent de Paul.

Sir Wm. Logan's description verified.

'The general structure of these two formations was found to agree with the description given by Sir W. Logan in the Geology of Canada (1863, p. 141), which is practically as follows : There is first a flat anticlinal arch, the axis of which runs from the north end of Mount Royal to a point a little westward of Ste. Thérèse. This anticline is traversed nearly at right angles by two others, one in each of the islands. This gives to the upper half of the Island of Montreal the form of a shallow trough.

Distribution of Utica shale

'The Utica floors the St. Lawrence river at Lachine between the breakwater and the shore, and below the Lachine Hydraulic Co.'s power house at Verdun, where it evidently extends inland for some little distance. It is also developed at Point St. Charles, below Victoria bridge, on the upper end of St. Helens island and off the wharf at Longue Pointe. Below the city the formation does not extend any distance inland, as Trenton rock was noted at Maisonneuve one-third of a mile from the river. Nor does it seem to underlie any great part of the city, for wherever borings have been made, limestone has been struck immediately below the hardpan. The Utica also appears on part of the east and north-east flanks of the mountain overlying the

Trenton limestone, and evidently in contact with the igneous rock. It is altered to a hornstone. Quebec—*Cont.*

'The St. Helens Island breccia, composed of a great variety of rock fragments cemented by a dolomitic paste, underlies the greater part of the island and all of Ile Ronde.* Its contact with the Utica is wholly concealed by drift. Considerable attention was also given to the igneous rocks of the area. The igneous mass of Mount Royal occupies an area of about one and a half square miles. A brief description of the rocks comprising it has been written by Dr. Adams. Theralite forms the greater part of the mountain. This rock is cut by the second intrusive, a nepheline-syenite, which appears as a band along the north-west flank of the former rock, having a width never exceeding 400 yards. Numerous dykes cut both the above igneous rocks as well as all the stratified rocks. They vary in direction from north and south to east and west. Intercalcated masses of trap are rather common. Besides the larger mass in Côte de la Visitation, noted by Sir William Logan in the Geology of Canada (1863 p. 144,) others of lesser importance were found at Rockfield station, Côte St. Leonard, lot 435, Rivière des Prairies village and St. Vincent de Paul in the Trenton, and at Verdun in the Utica formation.'

St. Helens Island.

Mount Royal an igneous mass.

Shefford Mountain.

Professor J. A. Dresser makes the following report on the examination of Shefford mountain, which he has been conducting and which is now approaching completion. He adds also notes on some adjacent parts of the province of Quebec which he has lately examined:—

Work by Prof. J. A. Dresser.

'The examination of the rock specimens collected from Shefford mountain in the seasons of 1897-98 and 99 has been continued during the past year and is now nearing completion. Some chemical analyses kindly undertaken by Mr. M. F. Connor, B.A.Sc., assayer, Ottawa, which will be of much service in the varietal classification as well as in the genetic consideration of the rocks, are also well advanced, so that the entire description will, it is expected, be finished at an early date.

Analyses nearly complete.

'As was stated in the Summary Report for the year 1899, Shefford mountain is an igneous mass having an area of some nine square miles, and is situated in the south-eastern part of the St. Lawrence valley near the limit of the Palæozoic strata, amongst which it has been intruded in three principal periods of irruption. The microscopic character of the rocks thus formed indicate a conspicuously alkaline composition, making the rocks all of rare types and greatly emphasizing the scientific interest to be attached to the locality. The earliest rock

Area of Shefford mountain.

*Annual Report Geol. Surv. Can., VOL. VII. (N. S.), pp. XI—12 J.

in order of intrusion, which is evidently the most basic, is an unusual variety of augite-diorite, being in part at least essexite, an intermediate type between diorite and theralite. The second and third intrusions are varieties of syenite closely analogous to certain of the rare alkaline rocks of Arkansas and southern Norway.

Large number of dykes.

'Besides these main masses there are large numbers of still later dyke rocks which are themselves of at least two different ages of intrusion. The first class consists of dark-coloured dykes generally of the lamprophyre group, which, however, frequently pass into the hypabyssal facies of their plutonic equivalents. The extremely coarse texture of many of the dykes of both series is a very noticeable feature, and is presumably an indication of the highly heated condition of the inclosing rock at the time of their formation. The dykes of the younger series, which frequently cut the others, are generally of a trachytic character. They occasionably become comparatively free from the iron-magnesia constituents, and then pass into the bostonite type.

Rocks of Brome and Shefford mountains similar.

'The peculiar characters of the rocks of Shefford mountain prove it to belong to the important series of intrusive mountains crossing the St. Lawrence valley, of which Mount Royal, at Montreal, is the best known member, and all of which, so far as known, consist of rocks of rare petrographic interest. With the adjacent mass of Brome mountain, which was stated in the Summary Report of last year to be lithologically similar to it, Shefford shares the most easterly position amongst these mountains, as far as known, which has naturally led to some investigation as to whether these are really the end of the series towards the east, or not.

Results obtained.

'The results thus far obtained seem to show that they are. A somewhat brief examination has been made along the principal highways from Shefford and Brome to Lake Memphramagog, and on the Orford mountain and on the old Missisquoi and Black River Valley railways from North Stukely southward to the Huntingdon mines, as well as a careful survey of the exposures along the Canadian Pacific railway from Shefford to Miletta have failed to show any but very dissimilar rocks to those of Shefford within the more sharply folded pre-Cambrian strata of the Sutton Mountain anticline. The serpentines, altered diabases etc., of the latter area are not rocks which suggest any genetic connection with the peculiar varieties which appear in the former locality. These field examinations, which have been made at various times, have been much facilitated by the courteous and valuable assistance of Mr. H.A. Honeyman, M.A., of Knowlton.

Acknowledgments.

'Dykes related to those of Shefford probably occur, however, for some distance to the east of that mountain. One such is a quartz-free porphyry in lot 24, range III of the township of Shefford. This was described by Dr. F. D. Adams, in the Report of the Geological Survey

for the years 1880-82, and is evidently allied to the rocks of Shefford mountain, from which it is about four miles distant. Some dykes which are found in lot 1, range X of Bolton, some twenty miles east of Shefford, are now being studied with a view to ascertaining the probability of their connection with that mountain. Quebec Cont.

'As however the course of the Appalachian folding is about at right angles to the direction of the Mount Royal and Shefford series of mountains, and as the folding of the former was doubtless begun before the intrusion of the latter took place, it seems probable that any further outcrops of rocks of these characters are more likely to be found along the course of the Appalachian uplift than in a line across it. A camptonite dyke which occurs at Richmond, fifty miles north-west of Shefford, but also near the western edge of the Appalachian folding, is a not unlikely indication of the occurrence of rocks of an alkaline character in the intervening distance. Intrusives along Appalachian uplift.

'There are several quarries on Shefford mountain which produce rock material of excellent quality for constructive and decorative purposes. The largest of these is that belonging to John Dorman, near Shefford Mountain post office This gives a rock of uniform hardness, texture and colour, the last being a medium shade of green. It is free from cleavage or fluidal structure, and appears in the polished column in every respect equal to the first class "granites" already established in the market. In the absence of crushing, absorption and other tests, or of the results of such tests on other Canadian "granite" for comparison, little of a more definite character can be said of it. Microscopically it is practically free from constituents that decompose readily or tend to tarnish the rock. This is also proven by the very slight discolouration shown on natural exposures. Building material. Composition of rock.

'Rocks of slightly different character, but probably not inferior quality, are found on the properties of J. Morriseau and Jas. Coupland, where quarrying to some extent has also begun. Some equally promising occurrences along the "mountain road" have not yet been opened. Owing to their favourable location and proximity to the railway these rocks can be quarried more cheaply than most of the standard granites, and bid fair to supply a large market in Central Canada at least.' Location favourable for production.

Lake St. John District.

With a view to completing the surveys necessary for the Lake St. John map-sheet, including the greater part of the shores of that lake and the adjacent country between the Mistassini and the Shipshaw, arrangements were made with Mr. G. A. Young to continue the work already accomplished in that region. Mr. Young has assisted Mr. A. P. Low in the field during several years, and is familiar with the Work by Mr. G. A. Young.

Quebec *Cont.*

conditions in various parts of northern Quebec and Labrador. Although the result of his exploration has afforded little information of a striking character from a geological standpoint, some considerable additions have been made by him to our surveys for the sheet in question. Mr. Young writes :—

Delayed by rain.

'On June 6th, I left Ottawa for Lake St. John. During the latter part of June and all July it rained more or less every day, retarding the work considerably.

Previous work done.

'The main rivers, comprised in the Lake St. John map-sheet, had already been traversed either by Mr. A. P. Low or Dr. F. D. Adams. Dr. Adams had also covered the settled districts which all lie in the southern part of the map-sheet. The nature of that part of the country still to be gone over, was such that progress was very slow, and the results are still, in part, incomplete.

Old lake bottom.

'Lying north of the settled districts, is a low level area almost completely covered by heavy deposits of clay, sand, gravel and boulders. A greater part is swampy and most of the streams are very small. This area forms the north shore of Lake St. John and at that point it is about fifteen miles wide. It extends to the eastward, gradually narrowing, and crosses the Shipshaw river as a narrow strip a few miles wide, about twenty-five miles above its mouth. This district probably, at one time, formed the bed of a large lake, including the present area of Lake St. John which was drained by a river running from about the south-east corner of the present lake to Ha Ha bay on the Saguenay. The country bordering this area to the north is very wild, the hills rising abruptly and to a considerable height. A short distance north, and to the east of the Shipshaw river, the hills rise nearly 2,500 feet above the Shipshaw which at that point must be almost 750 feet above the Saguenay river.

Rivers impassable for canoes.

'With few exceptions, the small rivers draining the country between the main rivers are impassable for canoes, being short and always very rapid. The whole country, excepting those parts that have been burnt, is covered by a dense forest, mostly spruce, which prevents the running of traverses from river to river and makes it impossible to run even a track-survey. All the valleys are covered by deposits of sand and boulders, and the heavy vegetation on the hills hides the rock except on the cliffs.

'During the winter it would be possible to make good surveys of the rivers and streams. Walking would be good through the woods, so that probably, many exposures on the faces of cliffs could be visited which is hardly possible during the summer.

Track-surveys made.

'By means of rough paths cleared by lumbermen, I was able to make track-surveys of a number of small tributary rivers of the Shipshaw. I

also made similar surveys of a series of small rivers and lakes which run from the Shipshaw twelve miles above its mouth, to lake Onatchiway, of another series crossing from the Shipshaw to the Peribonka, of a third series from the Peribonka to the head of Alex river, of the Alex river to its junction with the Peribonka, and parts of a small river by which we descended from the Peribonka to the Saguenay. Quebec—*Cont.*

'The routes followed lay almost altogether within the anorthosite area which forms so great a part of this district and whose main boundaries Dr. Adams had already determined. The prevailing colour of the anorthosite is a dark purple, excepting on the eastern border where it is grey. Dr. Adams has shown that this grey colour is due to a granulation of the feldspar individuals and the loss at the same time of their schiller inclusions*. This strip varies from a width of a few miles, at a point on the Shipshaw twelve miles above its mouth, to twenty-five miles at the foot of Lake Onatchiway. The width may be even greater here, for the grey anorthosite was found to extend twelve miles east of the Shipshaw, which was the farthest accessible point, and was then beyond the boundary of the map-sheet. Probably the contact with the Laurentain was not many miles farther on, as the anorthosite was modified so as to somewhat resemble the variety of anorthosite which, in the case of the Morin anorthosite, Dr. Adams considers to be due to contact phenomena. Anorthosite area. Probable contact with Laurentian.

'In this case the gray anorthosite appeared to change abruptly to a brown or pink colour and held quartz. This grey area also includes two comparatively small areas of augen-gneiss which has burst up through the anorthosite. This augen-gneiss in places contains much quartz and is massive, resembling granite ; but elsewhere it is banded, the strike being the same, or nearly that of the surrounding rock.

'About sixteen miles above the mouth of the Shipshaw, the line of contact between the Laurentian and anorthosite crosses the river several times, the Laurentian being either a granite-pink hornblende-gneiss or a grey mica-gneiss. The strike of the anorthosite and gneisses varies from point to point and does not coincide in direction with the line of contact. The anorthosite at this contact appears to be intrusive. Direction of strike and contact differ.

'The several varities of anorthosite already noted by Dr. Adams were seen ; anorthosite with no bisilicates—with a small amount—with irregular or lense shape aggregates of hypersthene or augite, these aggregates being arranged parallel so as to give an apparent strike. Sometimes the aggregates were evenly distributed, sometimes arranged Varieties of anorthosite.

* Annual Report, Geol. Surv., Can., VOL. VIII. (N. S.) p. 109 J.

Quebec (Con.)

in bands. In places the hypersthene exceeded the felspar in amount. Near one contact the aggregates were composed of large flakes of biotite. The aggregates varied from a very small size to over one foot and a half in length.

Composition changes quickly.

'In the grey crushed anorthosite, minute flakes of biotite were usually seen, and in places the biotite increased in amount, apparently replacing the usual bisilicates, so that the anorthosite appeared as a grey biotite-gneiss. The characteristics of the anorthosite rocks vary rapidly from place to place. In one place within one-quarter of a mile nearly all possible variations were noticed.

'The change from the purple to grey anorthosite was, as a rule, a gradual one, and there was always a certain amount of still uncrushed dark felspar present.

'To the west, on the Alex river, in two places, diabase dykes seem to have caused considerable local metamorphism. On the same river at different points the anorthosite has a schistose structure due to a large development of biotite and augite, the felspar being finely granulated except along narrow bands. In this area there were numerous pegmatite dykes which may indicate a near approach to the contact with the Laurentian and which may explain the highly altered character of the anorthosite.

Pegmatite dykes.

'Near one of the intrusions of augen-gneiss on the eastern side, the bisilicates of the anorthosite were in lense-like aggregates. At different exposures these were seen to become more and more elongated till gradually the several lenses joined one another and gave a banded character to the rock.

Glacial striæ.

'Three different sets of glacial striae were noticed. On the Little Peribonka the striae varied from S. 10° E. to S.; on the Alex and Peribonka rivers from S. 30° E. to S. 35° E., but at one exposure this set crossed another and older set, varying between S. 60° E. and S. 65° E. On Lake Onatchiway the direction was S. 10° E., and several sets east of the Shipshaw varied between S. 30° E. and S. 35° E.'

NEW BRUNSWICK.

Work by Prof. L. W. Bailey.

In New Brunswick work has been continued by Professor L. W. Bailey on certain problems of importance in connection with the geology of that province. The investigation of the past summer has had special reference to the age of the rocks of the so-called great slate belt. His report is as follows :—

Object of work.

'These explorations, in accordance with your instructions in May last, had as their principal object the obtaining, if possible, of a final and definite settlement of the age of the great bands of slates and

associated rocks which border the granite tracts of York and Carleton counties, which in earlier reports, were described and mapped as Cambro-Silurian, but were subsequently found to include strata carrying a typical Silurian fauna. New Brunswick Coal.

'The determination of this question having, in previous seasons, been found impossible through the want of sufficient surveys of the position and course of the rocks involved, more especially in tracts difficult of access, Mr. A. Cameron, previously engaged in survey work in Nova Scotia, was directed to accompany me as topographical assistant, and to make such measurements as might be required. These embraced the larger part of the roads in the parishes of Canterbury and Woodstock, together with traverses of Eel river and portions of the adjacent tracts which seemed to be of special importance. They also included, upon the eastern side of the St. John river, the district between Hartland and the north-east branch of the Beccaguimic river, the south-east branch of the same stream, the country thence to Millville, and that lying between Millville and Waterville. These surveys were subsequently plotted, enclosing the more critical areas in northern York and Carleton counties, and a map was made showing more clearly than had previously been possible the relations of the disputed groups. At the same time the included areas were subjected to a close and searching examination, all outcrops previously noticed being reviewed, new ones sought in places not previously reached, and in some instances attempts being made to follow for considerable distances the more easily recognized bands in the direction of their strike. Topographical assistant.

'The general tendency of these observations and measurements has been to confirm the view arrived at in the previous season, but not then announced owing to the incompleteness of the data, viz., that while a Silurian age must be assigned to certain tracts, such as that in which fossils were found by Mr. Wilson, of the Geological Survey staff, six miles north of Canterbury, and that discovered by the writer in the settlement of Waterville, in the parish of Southampton, yet the great bulk of the strata in the counties under consideration is, as previously supposed, of greater antiquity, being at least Cambro-Silurian or Ordovician (the age to which they had previously been assigned), if not even older. In seeking for evidence on this question a careful re-survey was made along the line where the supposed Cambro-Silurian or older rocks are met and overlapped by the fossiliferous Silurian rocks to the north, with the result that incontestible evidences of discordance is found along the whole length of that line. A new and well marked instance of this was seen near the head of Eel river, in South Richmond, Carleton county, where heavy Results obtained. Proof of former conclusion sought.

New Brunswick Coal.

beds of bright red slates, associated with amygdaloidal diorites, have afforded large fragments to the overlying Silurian beds.

Fossiliferous slates derived from Cambrian.

'An effort was then made to determine the limits of the fossiliferous Silurian rocks previously discovered by Mr. Wilson. Fossils similar to those obtained by that gentlemen, but occurring very sparsely, were collected at several points on Eel river, and strata exhibiting similar associations were followed for six or eight miles in the direction of the St. John river. Here, however, approaching the great granite belt, they not only failed to yield fossils, but became so greatly altered as to be recognizable only with difficulty. In connection with this work the fossiliferous slates were found to be associated throughout with heavy beds of slaty conglomerates, the composition of which, though somewhat different from that of the South Richmond conglomerates, equally indicate their derivation from the supposed Cambro-Silurian and Cambrian strata. The course of these conglomerates is therefore provisionally regarded as marking, upon one side at least, the line of separation of the two systems in the parish of Canterbury. The southern side, owing to progressive metamorphism, cannot be definitely assigned.

Conclusions verified by fossils.

'So far, the conclusions reached, though in accordance with previously expressed convictions, and with the views of all previous observers (including Logan, Hind, Robb, Matthew and Ells), were based upon stratigraphical and lithological grounds only. But near the end of the season, while engaged in an effort to effect more exactly the delimitation of the groups under review, new and most important evidence, tending to confirm the views already reached, was brought to light. This consisted in the discovery, near the village of Benton, in Carleton county, of a band of very black, more or less graphitic slates, associated with gray and white quartzites, and containing a few layers charged with large numbers of graptolites of the genus *Dictyonema*. Among these were some of large size, ($2\frac{1}{2}$ x 3 inches) showing both in their outlines and in the dimensions and structure of the polypary, a very close resemblance to the form *D. sociale* or *D. flabelliforme*, Eichwald, occurring in rocks of Cambrian age on Navy island, in the harbour of St. John, as well as at Matane, in the province of Quebec. They are regarded as identical by Dr. H. M. Ami, after careful studies and comparisons, and Dr. G. F. Matthew, (by whom the Navy Island form has been figured and described) is also disposed to adopt the same view. It would seem, therefore, that although the occurrence of a single fossil species is in itself very insufficient evidence upon which to determine and represent the horizon of a great group of strata, yet, when this is taken in connection with the stratigraphy of the region, pointing as it does in the same direction, a strong presumption is established in favour of the Cambrian age of the

Palæontological and stratigraphical evidence similar.

beds yielding these forms. It may be added that, should this view be confirmed by the finding of other fossils, the indications are that some closely associated, but underlying beds of semi-volcanic character, will be found to represent here certain strata found near St. John, to which Matthew has assigned the name of Etchminian, and which are regarded by him as indicating a distinct geological system. At all events the character and relations of the "volcanics" of Carleton county covering large tracts along the upper courses of Eel river and its tributaries, accord much more nearly with the association of similar beds in the Cambrian rocks of St. John, than they do with those of this character seen in their relations to the Silurian rocks of Charlotte county and elsewhere. New Brunswick Coast

'But while we are thus in possession of at least presumptive evidence of the existence in the district under discussion of two, or rather three, distinct formations, (for both of those referred to are somewhat unlike the Cambro-Silurian of the Beccaguimic river, no trace of which could be definitely recognized elsewhere), the determination of the exact extent and location of each is by no means easy. Very similar strata are found in both; in each they have been subjected to excessive plications, so that observations of dip and strike are of little service; they are most irregularly associated with volcanic ejecta, or invaded by intrusive masses, while finally, just when exposures are most needed, the country is deeply covered with drift. It may, however, be said with some confidence, that the Silurian rocks include all those exposed along the line of the railway, and in Eel river near by, between the main bend of this stream, about five miles north of Canterbury, and the Eel River falls, three miles farther north; and that from this line the belt extends eastward through Porten and Johnson settlements to the St. John river above Sullivans creek. Upon the eastern side of the river the same belt may, in an altered form, be continuous with the fossiliferous Silurian limestones discovered last year in the settlement of Waterville, but of this no proof could be found. The limestones in question, with associated conglomerates, are quite limited in distribution, have not been found elsewhere, and are surrounded by rocks of which the aspect is much more like that of the Cambrian than that of the Silurian system, as known elsewhere. Area of Silurian rocks.

'The question referred to above constituting the main subject of my season's work, and their solution being apparently dependent mainly upon the correct understanding of the belt of slates and associated rocks north of the great granite axis, especially in the parishes of Woodstock, Canterbury, Northampton and Southampton, and the study of these, as above outlined, having occupied the larger part of my available time, no further special examinations were made of the Silurian question difficult.

New Brunswick—*Cont.*

slaty belts south of the same axis. The recognition, upon the evidence of fossil graptolites at Benton, of the probable Cambrian age of the associated rocks (slates and quartzites), certainly also lends a degree of probability to the references to the same horizon of a portion of the beds (also slates and quartzites) south of the granite; but the fact that fossiliferous slates of Devonian age are found among the strata in the Nashwaak valley (Rocky brook), thus adding another to the horizons represented in this complicated district, shows that much careful work must yet be done before the relations and boundaries of these several formations can be accurately known.

Search for minerals.

'While carrying on the above investigations, examinations of several localities which seemed to afford some promise of useful minerals were made. One of these was in the settlement of Knowlesville, in the parish of Aberdeen, Carleton county, where, upon the farm of Mr. S. R. Gayton, an opening had been made in a series of slaty rocks, in part soft or rubbly and in part much harder, with rotten layers containing much pyrites. Samples taken from this point and analysed in Philadelphia, gave returns as follows:—

	Gold.	Silver.
Soft Rock	$1 16	$0 42
Blue Rock	1 30	0 80
Hard Rock	2 40	0 22

'A second locality was in Biggar Ridge settlement, three miles east of where the road from Foreston crosses the south-west Miramichi. Here are very large beds (?) or veins, consisting mainly of white quartz, often coarsely crystalline, more or less stained with iron and manganese, and frequently showing sulphides of iron, lead and zinc, with films of malachite. Specimens selected from openings made here, and analysed in the laboratory of the Survey, gave, according to the report of Dr. Hoffmann:—

Gold.....None.
Silver .At the rate of 0·583 of an ounce to the ton of 2,000 lbs.

Indications of iron ore.

'Reference may also be made to the strong indications of iron ores observed at various points in connection with the volcanic or semi-volcanic rocks so largely developed in Oak mountain and above the sources of Eel river in South Richmond. Beds approaching hæmatite in character were referred to in the report of 1884, as occurring on Oak mountain, and during last summer a thirty-foot bed of similar red hæmatitic slate was observed on the farm of Mr. Kennedy in South Richmond, the same as referred to earlier in the report. Samples from the latter analysed by Dr. Hoffmann showed only 5·71 per cent of metallic iron, equivalent to 8·15 per cent of ferric oxide, but it is not unlikely that with these are beds carrying a much higher percentage.'

New Brunswick Coal

Mr. R. Chalmers was engaged during the winter of 1899-1900 in compiling the information obtained in the field in 1898 and 1899, and in preparing for publication the Fredericton and Andover sheets, No. 1 N.W. and No. 2 S.W. of the New Brunswick series. A report embodying the principal facts respecting the surface geology and the soils and forests was also written to accompany these sheets.

Work by Mr. Chalmers.

Surface Geology.

During the past season Mr. Chalmers was instructed to continue investigations in the surface geology of north-western New Brunswick, chiefly in the area included in the Grand Falls sheet No. 2, N.W. Work was commenced here in the valleys of the St. John and Tobique rivers in Victoria and Madawaska counties, and was extended northward and eastward into the unsettled areas drained by the upper Tobique waters. Special attention was given to the alluvial deposits of the Right Hand branch of this river owing to the fact that they contain scattered particles of gold. An attempt was made to trace these to their source and ascertain as far as practicable, the limits of these auriferous beds in a region still wholly covered by forest.

Mr. Chalmers reports as follows:—

St. John and Tobique valleys.

'I left Ottawa on the 12th of June to resume work on the surface geology of New Brunswick. Mr. L. P. Silver of Kingston, Ont., accompanied me this season also for about four months. Explorations were first undertaken in the south-west part of the Grand Falls sheet, in the valleys of the St. John and Tobique where the country is settled back from the river to the third and fourth concessions. A considerable number of new roads, which have been opened up since the Geological Survey map of 1886-87 was published, had to be surveyed, which we did by prismatic compass and wheel, and the shorter ones by pacing. Settlements seem to be rapidly extending in this part of the province, particularly on the north-east side of the St. John. Of these settlements those of New Denmark, Salmon River, Enninshone, Woodville, Chambord and Commeau Ridge are the most thriving and embrace tracts of excellent uplands. The soil is often a calcareous loam and river flats (intervales) skirt all the rivers. The forest consists of a heavy growth of mixed timber.

Heights at Grand Falls.

'The valleys of the principal rivers in this region, notably the St. John, Tobique and Aroostook present a number of very interesting features, and some problems in Pleistocene geology, for solution. Among these are the falls of the St. John, known as Grand falls, the most important in the province. These falls consist of a nearly perpendicular drop of about 60 feet, with a series of rapids and cascades below this in a gorge some three-quarters of a mile long; and quiet pools above and below called the upper and lower basins. The total descent

New Brunswick Coal

of the river from the upper to the lower basin is 117 feet. The falls have been caused by the filling of the ancient valley of the river by boulder-clay during the glacial period and perhaps by a transverse dislocation of the strata, resulting in a diversion of the river from its old channel to a new one eroded in solid rock. The wearing out of this channel or gorge with walls from 75 to 150 feet high, nearly vertical, is not yet completed, the excavating or cutting process being still in progress. This gorge is the most remarkable feature in connection with the falls, and is, in places, quite picturesque, having a curved or horseshoe shape from the upper and highest fall to the lower basin. Large pot-holes occur in its bottom, which arrest the attention of the observer who descends into the gorge. Two of these situated about a quarter of a mile below the upper fall, or suspension bridge were measured. They are somewhat oval-shaped at the mouth, the longest diameter being parallel to the direction of the gorge. One is 12 feet by 11 feet at the mouth, and the depth 22 feet to the top of the gravel and pebbles in its bottom. The other,

Pot holes.

which has one side of the mouth broken off, has about the same diameters as the last; but narrows from the top downwards, its depth being 27 feet to the stones and gravel in the bottom. Probably there was a depth of several feet of these materials in each. The geological formation here is Silurian limestones and slates.

'The boulder-clay filling which caused these falls can still be seen occupying the pre-glacial valley of the St. John here for a distance of 865 yards, and is exposed at both the upper and lower basins. A small channel along the surface of the deposit follows the course of the pre-glacial river. This channel at the upper end is 51 feet above the level of the upper basin, but slopes slightly toward the lower basin. The September level of the upper basin is 412 feet above mean tide level in Passamaquoddy bay, and of the lower 295 feet, as levelled from the Canadian Pacific railway station at Grand falls, which is 504 feet above the same datum.

Height of Upper basin.

Terraces.

'The St. John valley at Grand falls is flanked by terraces, the highest of which, at the upper basin, are from 95 to 110 feet above the river, or 522 feet above the sea. These terraces are practically at the same height on both sides and are continuous for half a mile or more below the lower basin except where intersected by Little river and Falls brook. Their surfaces incline down river from the level of the horse-shoe shaped peninsula on which the village of Grand Falls stands, about 520 feet high, and the materials seem to become finer, or rather there are fewer coarse gravelly bands as we descend the St. John. About half a mile below the lower basin the same terrace was found to be only 475 feet above the sea, while farther down the longitudinal slope was observed to be still greater. These facts serve to show

that when the St. John began to resume its course at the close of the glacial period, its waters flowed at this level for some time, forming these high level terraces. Lower terraces much better developed than these are, however, found in this valley. New Brunswick—*Cont.*

'Drift or boulder-clay dams and, perhaps, local temporary ice dams seem to have been formed in the St. John valley in the glacial period at and below Grand falls and in different places as far down as the mouth of the Keswick river. The terraces are usually at a different level below where these dams existed to what they are above. Scarcely any remnants of these drift dams can now be seen, except on the higher slopes of the river's bank where the boulder-clay rises from beneath the fluviatile beds. Drift dams.

'The terraces are higher relatively to the river and much better developed below Grand falls than above. This appears to be due to the greater slope of the channel and the more rapid flow of the St. John in the former part of its course, causing the transportation and modification of a much greater quantity of the boulder-clay which originally occupied the valley. Above the falls, and as far up as Edmundston, 40 miles, the St. John has but a slight descent and a comparatively tranquil flow, hence there was less erosion of the boulder-clay, less transportation of materials, and consequently the terraces here are comparatively insignificant features. There are evidences in this part of the valley, however, that lacustrine conditions probably prevailed during that part of the Pleistocene immediately succeeding the glacial period, the lake having apparently been held in by the boulder-clay embankment at Grand falls to a height equal to that of the highest terraces at the falls, namely 520 feet above the sea. Deposits which probably represent shore-lines were observed on the east side of the St. John between Grand falls and St. Leonards at the same level. On the other hand, it is not improbable that the Pleistocene sea invaded the upper part of the St. John valley, if not from the Bay of Fundy, then from the St. Lawrence by Temiscouata lake. At the time that the highest shore-lines of this valley were formed, the sea probably found a passage into this lake basin from Trois Pistoles or Rivière du Loup, and thence could easily reach the St. John valley. Pleistocene shore-lines.

'No fossils have yet been detected, however, in the sands or clay of the upper St. John, or Lake Temiscouata basin.

'The gradient of the river valley from Grand falls to Edmundston is but slight, and the terraces here are nearly horizontal, or have only a gentle slope down river. This would mean, if they are marine that they have a slight ascent from the north-east to south-west as in the St. Lawrence valley. Between Grand Falls and Woodstock, however, the terraces everywhere have a greater slope down river, in some

New Brunswick—*Cont.*

places the gradient being regular, in other places they descend by steps. In this part of the valley they are fluviatile.

Aroostook Falls.

'The falls of the Aroostook river, two miles east of the International boundary were also examined. Here the river descends about 75 feet, in a distance of a mile and a half in a succession of beautiful cascades. An ancient channel runs on the south side parallel to the gorge in which the river now flows. The deposition of boulder-clay has also been the means of producing these falls; but a diorite dyke which cuts the slates here in a peculiar manner appears to have caused a dislocation of the river channel at a former period.

'The Grand falls of the St. John and Aroostook falls are well situated for the utilization of the water power they afford. A syndicate of United States and Canadian capitalists has leased the Grand falls, surveyed the ground, and it is reported, has prepared plans for the erection of extensive factories, but nothing further has yet been done.

Boulder-clay.

'*Boulder-clay*:—This is probably the most abundant of the superficial deposits in the area under consideration, and seems to form an almost continuous covering of the rocks. In the river valleys it is, of course, largely concealed from view by the later stratified deposits; but above the limits of the highest terraces nearly all the drier grounds show boulder-clay, the upper surface of which is often modified by ordinary atmospheric action.

Boulders.

'Numerous boulders occur scattered over parts of the area, but they seem to belong to rocks found within the drainage basin of the St. John river. A few gneiss boulders were, however, met with in the boulder-clay at Grand Falls and Edmundston, the sources of which are unknown, and which may be derived from the great Laurentian area to the north. Similar boulders were observed at Temiscouata lake some years ago. Has the lobe of the Laurentide glacier which overrode the eastern townships of Quebec extended down the St. John valley this far?

'Decayed rock was observed in a great many places, especially on the south sides of hills and ridges where it had been protected from the scouring action of the Pleistocene ice. It is, however, on the higher and more broken grounds of the interior that the material is most abundant.

Surface geology of Tobique valley.

'The surface geology, physiography, etc., of the Tobique valley and its eastern tributaries being the principal subjects of our investigation, we commenced this work in July, and our time for nearly the whole of the rest of the season was occupied in it. Many interesting facts were collected, a few of the most important of which will be detailed in the following pages. Commencing at Plaster Rock, the terminus of the Tobique Valley railway, we first examined the valley of the

main Tobique river to Nictau, where it divides into three branches. All new roads were surveyed and the altitude of the country measured with aneroids based on the profile height of Plaster Rock station. Dr. Philip Cox, of the Miramichi Natural History Association, who was making collections of fishes, reptiles and plants, etc., joined us in camp for a few weeks. With his aid the two highest peaks of the Tobique valley, namely, the Blue mountains and Bald head, Riley brook were re-measured. The summit of the former was found to be 1,725 feet above sea-level, and of the latter, 2,045 feet. As there are so many Bald mountains in the province it seems desirable to change the name of this mountain. I shall therefore call it Riley Brook mountain, or simply Riley mountain. By this name it can still be recognized by lumbermen, sportsmen and others familiar with the region more readily than by giving it an entirely new name. New Brunswick *Cont.* Elevations.

'Several Pleistocene river expansions, or lake basins, holding lakes in post-glacial time, but now extinct, seem to have existed in the Tobique valley. The largest of these was in that part of the valley between Red rapids and Arthurette, another was at Riley brook. The flats at these places are evidently ancient lake bottoms, and now form a highly fertile soil.

'The general height of the country on both sides of the Tobique, from the Arthurette basin to the forks (Nictau), is approximately 750 to to 1,000 feet above the sea, becoming higher, however, to the east, north and west. The whole region, except along the immediate banks of the river, is wooded, and has a broken, rugged surface. This portion of the province lies within the limits of the New Brunswick Land Company, the eastern and northern boundaries of which are the county lines of Northumberland and Restigouche. It comprises one of the most valuable timber areas of New Brunswick and some excellent farming lands.

'After completing the work in the valley of the main river, arrangements were made to explore the lake region at the source of the Right Hand branch and especially the Serpentine river, where traces of alluvial gold have recently been found, and several weeks were spent in this part of the country. Our route on entering it was along a portage road starting from Tobique river, north of the Gulquac, thence to Trousers lake, one of the worst roads in the province. Several high ridges were crossed, the highest being the one east of Stewart brook, the principal summit of which is named Black peak on the Geological Survey map, but Dickenson mountain on the New Brunswick Land Company's plans. Its elevation is approximately 2,000 feet above the sea. East of this the road descends gradually towards Trousers lake. Much of the land along this route is poor and unfit for settlement, though in some places there are belts of good soil. Search for gold.

New Brunswick Coast.

The whole country is still covered with timber which renders it of great value. Just before reaching Trousers lake, we pass the north end of a mountain range trending in a nearly north and south direction, and shown on the map as having three prominent peaks. These mountains can be seen from the north-east side of the lake, and are probably the highest in the region, the elevation of the chief summit being approximately 2,250 feet above the sea. They are without a name on the Geological Survey map, and I therefore propose that they be called the Costigan mountains, after Hon. John Costigan, Trousers lake and vicinity having been a favourite hunting and trapping ground of his for many years.

Lakes on south-east branch.

'Trousers or Tobique lake is 1,350 feet above mean sea level, and its depth varies from 25 to 50 feet. Its bottom is traversed by low ridges with intervening hollows, though, on the whole, comparatively flat and silted up. The basin of the lake was originally two river valleys, that is, two valleys occupied by branches of the same river, which joined at the north end of the present lake, where a drift dam now exists.

Trousers lake.

'Crossing from Trousers to Long lake we pass through Mud lake, a small shallow sheet of water, about 1,365 feet in elevation. Long lake, the largest of the group, 1,320 feet above mean tide, is a beautiful expanse of water, and the deepest of all these lakes. The bottom seems to be quite uneven, however, the depth varying from 35 to 75 feet or more. The south end is largely silted up; but ridges of gravel and boulders occur in places throughout its bottom. This lake has also been produced by the damming up or dislocation of the upper part of the valley of River Don. At present it seems to be held in by a moraine; but there has also been another outlet to the west of the existing one, which drained it into Second or Square lake, so called by the lumbermen and hunters.

Long lake now drains into Third or Mud lake. The height of Mud lake is about 1,300 feet. It is quite shallow and apparently a resort of moose. From this lake a portage of three miles takes us to two other lakes,—they are mere sinks,—lying in a narrow valley and discharging into Portage lake. There is a high ridge to the north of these. A short portage takes us thence to Portage lake, a beautiful little lake about 1,150 feet in elevation, and from 15 to 20 feet deep, surrounded by low hiils. Beaver are abundant here; several dams and houses were seen, some with freshly cut bushes and sticks. Trout are also very plentiful in this lake,. This lake is likewise being silted up, and is another drift-dammed body of water, the obstruction being at one side instead of at the end.

Portage lake.

'From Portage lake a short carry or portage takes us to Adder lake which is about 50 feet higher than Portage lake, that is, it has a height above the sea of about 1,200 feet. This pretty little lake, nestles at

the western base of a mountain 1,655 feet high, which may be named Adder Lake mountain. The depth of the lake is from 16 to 18 feet and it discharges into Serpentine lake. New Brun[illegible]

'A stream flowing into the southern end of Adder lake, drains a lake about three quarters of a mile to a mile distant, of about the same size. As the latter is without a name, I propose to call it Loggie lake, after T. G. Loggie, chief draughtsman of the Crown Lands Office, Fredericton.

'Serpentine lake is reached from Adder lake by a short portage, the stream connecting them being choked up with drift-wood and impassible for canoes. This is another fine sheet of water, with high mountains to the east and south, and a depth varying from 25 to 60 feet or more. Its elevation above the sea is 1,165 feet. The long points extending into it are probably moraines. A mountain stands on the east side of the outlet with a height of approximately 1,800 feet above the sea. This I propose to name Serpentine mountain. Serpentine lake.

'Serpentine lake seems to be held in also by a drift dam. Terraces 10 to 12 feet above its level occur on both sides of the outlet or foot of the lake, composed of stratified materials in the upper part and boulder-clay beneath. But while all these lakes appear thus to occupy portions of ancient river-valleys, dislocated and partially cut off from those parts below by dams of glacial drift, it is doubtful whether such dams are alone sufficient to produce them. Neither does it appear probable that glacier-ice would form drift-dams in such regular alignment across the country in a north-east and south-west direction, corresponding so closely with the strike of the geological formations. Another hypothesis has, therefore, to be introduced to aid in solving the problem of the origin of these lakes, namely, that of an uplift along the north-east and south-west line indicated, an uplift which would affect all the river valleys referred to, cutting off their upper parts and forming separate basins of these. Drift accumulations have doubtless aided in ponding the drainage waters of these basins, but as the boulder-clay would be laid down unevenly, and in loops or zigzag lines, it is scarcely possible that this alone could dam all these river valleys and produce these lake basins as we now find them. On the other hand the uplift has probably not been so regular, or along such a direct course as it appears to have been. It is most likely that it was parallel to the general trend of the pre-Cambrian belt, though, perhaps, irregular in detail. It may have been the same uplift which separated the Nepisiguit and Tobique waters, its axis passing between the Nepisiguit and Nictor lakes. The vertical movement referred to seems, however, to have been parallel to and subsidiary to the main uplift to the south-east, represented in the central granite and pre-Cambrian ridges traversing the province in a north-east and south-west Origin of lakes. Uplift of country.

New Brunswick Coal.

direction across the headwaters of the Miramichi rivers and the Nipisiguit near Indian falls, and was probably of a later date.

'A number of the lakes described are raised from five to ten feet above their normal level by artificlal dams, and at the time of our examination the shores and the borders were in a drowned condition. Rows of dead trees, some standing, others uprooted, form a border to these lakes at present, and mar their beauty. Where no artificial dam has been constructed, as at Long lake, the outlet is usually choked up with drift wood, which partially has the same effect in holding up the lakes above their normal level.

Serpentine river.

'The Serpentine river is a winding stream, with a stony, bed, and is very difficult of navigation for the canoeman or voyageur. Four or five miles below Serpentine lake, we come to a stretch of dead water about two miles in length the height of which is about 1,045 feet above the sea. Below this the river descends more rapidly. A range of mountains extends along the east side of this part of the river which is also without a name on the map. To these I shall give the name of Stillwater mountains. Their height is approximately 1,800 feet above the sea.

'At the mouth of a brook coming in from the east immediately below the dead water (McNair's brook) colours of gold and considerable quantities of black sand were washed out of the river's bank. The river gravels here contain a large percentage of quartz pebbles, and may be called quartz gravels. The source of these was not ascertained, but it is probably in the mountain range to the east, as this material is abundant in the brook just mentioned, which flows through these mountains and from the high grounds beyond.

'The portion of the Serpentine river below the dead water was examined in the autumn of 1899, and briefly described in the Summary Report of that year. From this point to its junetion with Campbell river it is remarkably swift, descending in the twelve intervening miles about 450 feet. The channel is also plentifully strewn with boulders, and cascades and waterfalls occur at intervals. The most interesting and important of these is the big falls, a series of rapids and pitches in which the river descends about 28 feet. These falls are caused by a granite dyke, and no evidence of an old channel could be seen on either side. As pointed out there is probably a fault here with a down-throw to the north-west, and this movement is doubtless related to that which produced the lake basins described above.

Alluvial gold.

'*Alluvial Gold.*—Washing for alluvial gold was conducted in all the lake basins, more particularly at and near their outlets, as well as on the upper part of the Campbell, Don and Serpentine rivers; but none was obtained till we reached the foot of the dead water of the Serpen-

tine river above referred to. Here, in washing a quartz gravel, fine colours were found. Below this, as far down as the junction of this river with the Right Hand branch, gold was obtained in a number of places by myself, and by others previously, showing that the precious metal has been distributed along the whole lower ten or twelve miles of its valley. It occurs, however, in a very fine state of division and in an extremely scattered condition. I have been informed that in addition to the small nuggets and grains of gold obtained in 1899, others weighing from ten to fourteen grains have been discovered, and some of these were shown me. Reports are also in circulation that gold has been found in the matrix in the elevated wooded country to the east of the Serpentine river and lake, at or near the source of the Little South-west Miramichi, and specimens rich in gold have been shown me by persons who stated that they collected them in that region, but wished to keep the precise locality a secret till further exploration was made. New Brunswick *Cont.*

'The alluvial gold of the Serpentine valley has, doubtless, its source in the rocks within the drainage basin of the valley, probably in the higher grounds referred to, east and south-east of this river, and at or near the contact of the old rocks mapped as pre-Cambrian with the granite. No gold has yet been found in the matrix, however, though various reports are in circulation to the effect that it has; but the samples tested in the three-stamp mill erected in the Serpentine valley a few years ago, as well as those assayed in the laboratory of the Geological Survey, have failed to show it. Probable source of gold.

'Although no alluvial gold was found by me in the lake basins at the source of the Right Hand branch, yet it is not improbable that it may occur there in small quantities, as was shown by Prof. H. Y. Hind, in 1864.* These lakes have their banks in such a flooded condition now by artificial dams and other obstructions that only in a few places could the rock *in situ* be seen. Besides the outlets were so blocked up with driftwood, that no fair test of the alluvial deposits in these could be made for gold. From all the information at hand, however, it would appear that the southern limits of the gold-bearing deposits of the Serpentine and Right Hand branch do not reach the lakes, but coincide approximately with the axis of the uplift that produced the lake basins, which as shown on a previous page is supposed to extend in a north-east and south-west line to the north-west of these lakes.

'In that part of the Serpentine valley in which alluvial gold occurs the valley is wide and the descent greater than in the upper part, and the deposits are shallow. Here boulders of all sizes strew the river's Mode of occurrence.

*A Preliminary Report on the Geology of New Brunswick, 1865, pp. 223-227.

New Brunswick

bed and ledges or rock in sight are not infrequent. It is usually below these ledges, in places sheltered from the great force of the current, that particles of gold are found. The river is extremely winding in this part of its course, fully justifying its name, and the scattered condition of the gold particles is largely due to its peculiar character. In a number of places old channels lie on one side or the other, which are now filled up and deserted by the stream Wherever openings have been made in these, colours of gold have likewise been found. The tributaries of the Serpentine too, from McNairs brook down, especially on the east and north sides, seem to have traces of alluvial gold in the gravels at the mouths. Much more prospecting and detailed work are necessary, however, before it can be said that a thorough examination of the region has been made in regard to the occurrence of gold in it in paying quantities.

'The probable source of the gold met with in the alluvial deposits of the Right Hand branch of the Tobique is the pre-Cambrian rocks of the central part of the province. These constitute a parallel band or outlier of the rocks forming the central axis of the Appalachian range, in which gold has been found from Georgia and Alabama to Maine and Quebec. In its mode of occurrence and distribution, the gold of northern New Brunswick appears to be similar to that of the Chaudière valley and other places in south-eastern Quebec.

'No prospecting or development work of any kind, so far as I could learn, was attempted during the season of 1900, nor have any areas of paying deposits yet been located.

Topographical features.

'*Chief topographical features.*—The lake region just described lies in the south-west part of a wide belt of highlands traversing New Brunswick from the head of the main South-west Miramichi river north-eastward to the sources of the Tête-à-gauche and Jacquet rivers flowing into the Baie des Chaleurs. This wide belt not only contains the highest land of the province, but also some of the oldest rocks consisting, as already stated, of pre-Cambrian schists and slates, with granites and other intrusive rocks. A large number of elevations in these New Brunswick highlands are 2,000 feet above the sea, or more, and several exceed 2,500 feet. The highest part of the country is near the source of the Big South branch, Nepisiquit river, and the sources of the North-west and Little South-west Miramichi rivers. These highlands are nearly all forest-covered and have of late years become a favourite hunting and sporting ground. Moose, deer, caribou, bears, etc., are plentiful there, and the fur-bearing animals, at one time nearly exterminated, are now, under the protection afforded them by the provincial game laws, beginning to increase in numbers again. The rivers and lakes in these highlands teem with salmon,

Game and fish.

trout, togue, etc. For a number of years the Tobique river has been under lease to the Tobique Salmon Club, and being well guarded, is now one of the best salmon rivers in New Brunswick. Besides the revenue derived from the lumber lands, which here are quite important, that accruing from the fisheries and game must, likewise be considerable. New Brunswick—*Cont.*

'In a late report the writer tentatively advanced the scheme of setting apart this large central belt as a game and forest reserve, following the example of other countries which are now reserving wilderness or waste lands for similar purposes. As regards the forests of the province it is generally conceded that the existing methods of exploiting them are destructive and must result in deforesting the wilderness lands in the near future. Hence the necessity of casting about for some nethod of preserving them. As the settlement of the country advances, this is, of course, impossible on areas of arable land. But there are large tracts useless for any purpose, except for growing timber, and these should be brought under control and the forest growth upon them preserved, or, if destroyed they should be reforested. The timber on forest areas might also be carefully culled and that above a certain size cut away periodically without destroying the younger and growing trees, and thus the life or existence of the forests might be indefinitely prolonged. The time is now opportune for setting apart such portions of the provincial lands as are not adapted for agricultural purposes and settlement, and placing them under such regulations as to ensure the preservation of the forests, game and fish. These are among the most valuable assets of the country, and their care and preservation are matters in which every citizen should be interested. Game and forest reserve advocated.

'The forests of the Tobique area consist of a mixed growth of trees, which may be enumerated in the order of their abundance as follows: fir, black and white spruce, black birch, large yellow birch, white birch, maple, cedar, hacmatac, pine, etc. Extensive lumbering operations are carried on here, especially in spruce and cedar. The hemlock was not observed in the country drained by the upper Tobique waters, nor indeed anywhere in the region above Three brooks. Timber.

'Though the salmon does not ascend the Right Hand branch of the Tobique to the lakes, the branches of this river form excellent breeding grounds for this fish, and in autumn the deeper pools were swarming with them. Trout are also especially abundant in all these waters. The togue is found in Long and Serpentine lakes, but has not been seen in any of the others, the reason apparently being that they are too shallow and their bottoms silt-covered or muddy. The beaver, at one time nearly exterminated in the province, is beginning to increase in number in these lakes, the fresh work of this animal having been seen at Portage lake and elsewhere indicating quite recent or present occupation.'

Nova Scotia.

Work by Mr. H. Fletcher.

Mr. H. Fletcher was engaged during the winter of 1899-1900 in plotting the surveys made in Cumberland county, N. S., referred to in the Summary Report for 1899, pages 162 to 168, and in making sections of the bore-holes therein described. He left Ottawa on June 7th, for field-work in Nova Scotia, and did not return to Ottawa until January 9th, 1901. On the field-work he makes the following report:—

Work by Mr. McLeod.

'I was again assisted by Mr. M. H. McLeod, who had with him for about two months early in the season, Mr. Colin McLeod, of Springhill, and in the months of September, October and November, Messrs. A. Cameron and Walter McKay, to finish surveys necessary to complete map-sheets 61, 62 and 63. They surveyed the various brooks, rivers, lakes and roads in the district of Folly lake, Wentworth, Westchester and Castlereagh, and along the Wallace, Pugwash and Philip rivers, and defined the extent and geological structure of the pre-Carboniferous, Carboniferous and Permian rocks of that region, the general outlines of which had been previously indicated by the late Mr. Scott Barlow and by Dr. R. W. Ells.

'My own time was divided between a study of the south-western corner of the Springhill coal-fields, and a further examination of the Inverness coal-fields.

Springhill.

'In the work at Springhill I was assisted by Mr. Lee Russell, B.S., of Truro, for several weeks. I have again to thank Mr. J. R. Cowans, general manager of the Cumberland Railway and Coal Company, and the gentleman mentioned on page 163 of last year's Summary Report, as well as Messrs. Jenkins Morgan, John W. Hunter, William Simmons, E. Trousdell, E. Corbett and others for assistance.

Coal seams traced.

'Seventy-eight hand-drill borings, ranging in depth from ten to fifty feet, together with several pits, have been made to define the course of the coal seams along the anticline already described as passing south-westward through this district from Clairmont toward the Upper Maccan river at Mapleton. By means of these bore-holes, the Golden seam* has been traced about 2,100 feet to a point near Trousdell's spring, from which it turns to the eastward round the anticline, but was not followed.

'The next seam to the south-westward, however, which may be called the Canning seam, was traced from the quarry in Harrison brook, about 250 feet below the bridge on the Leamington road, for more than 300 feet to the south-westward, then across the road, sharply

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* Summary Report, Geol. Surv., Can., 1899, page 167.

around the anticline and for 1,400 feet to the eastward. It is overlain by a thick belt of the gray massive sandstone of the quarry, but immediately above and below it lie dark gray argillaceous shales. Nova Scotia Coal.

'The Canning seam may be that cut through in Harper's bore hole at about 322 feet from the surface.*

'The anticline here passes to the westward of the road; and the next coal group, opened on both sides of the road, about 3,350 feet from Harrison brook, or 250 feet north-east of the road to Mr. J. W. Hunter's house, is on the south side of the anticline. This may be called the Dan McLeod seam; it is associated with thick beds of dark gray argillaceous shale and was bored into also at the old Mountain road half a mile to the westward, but has not yet been traced northward to the apex of the anticline. In many respects it is like the coal at Alex. Stewart's, and may prove to be the same.

'These explorations and the extension of the 2,600-foot level of No. 3 seam to a point nearly half a mile south-west of the Athol road or a mile and three quarters from the north slope, indicating that Barlow's "highest seam"† ought to cross Harrison brook—which is only two miles and ten chains from that slope—about 3,900 feet below the bridge on the Leamington road. It was looked for there; and a bed of coal and shale, six feet five inches thick, containing nearly two feet of coal, was found lying between two bands of sandstone inclosed among red strata. This coal was traced about 2,000 feet to a small fault across the old Mountain road. The associated red strata were followed 2,400 feet farther to the south-westward, then 1,000 feet around the point of the anticline; but work was discontinued before this seam had been located exactly or its relation defined to the seam of the 715 foot bore-hole, one mile and a quarter to the south-westward. Evidence from mine workings.

'The coal basin as thus proved has a breadth of more than four miles from the workings of the Aberdeen slope on the north-east. Its extension much farther to the south-westward may reasonably be expected, while the extension of the Aberdeen levels in the opposite direction will be awaited with interest. Extent of basin.

'Nearly eight weeks were spent in Cape Breton, principally in re-examining the Coal Measures of the western or Inverness coal-field between Margaree harbour and Little Judique, to the development of which an inpetus has been given by the construction of a line of railway from Port Hastings to the Broad Cove mines and the projection of another from these mines to Whycocomagh and Orangedale. Inverness coal-fields Cape Breton.

* Ibid, page 167.
† Ibid. p. 166.

Nova Scotia *Cont.* Mabou.

'Several small cargoes of coal have been shipped from Mabou and the mines at Port Hood and Broad Cove have also been reopened. The Richmond and Inverness Railway Company has the rails laid for construction trains to within about three miles of the mine at Broad Cove, while that portion of the road from Hastings to Mabou is nearly completed.

Port Hood.

'At Port Hood mines, the slope is now down about 1,150 feet, the dip being throughout about 24 and the coal about seven feet thick. Levels have been turned away north and south and balances and cross-cuts begun. The following analyses of the coal were made recently.

	Face of slope.	Face of south level.	Face of north level.
Moisture	2·11	2·47	2·42
Volatile combustible matter..	38·36	38·48	37·18
Fixed carbon.....	49·25	50·39	50·96
Ash	9·78	8·66	9·44
	100·00	100·00	100·00

'The manager, Mr. John Johnstone, is of opinion that the present output of one hundred tons a day can be increased to four hundred tons by the first of June, when an engine and fan are expected to be in position and shipping will begin from the company's pier. A $70,000 plant is to be erected in addition to the pier. Twenty-five miners and loaders are employed at present and this number will be increased as the mine is opened out.

Broad Cove.

'Active work on a large scale has also begun at Broad Cove mines. Not far north of McIsaac pond, two slopes have, under the superintendence of Mr. Charles Fergie, been put down between 700 and 800 feet on the so-called seven-foot seam. At 680 feet, No. 1 lift is turned off, levels are driven east and west and a water-lodgment made to continue the sinking of the slopes, which is expected to go on at the rate of 200 feet a month. Both slopes have been arched with stone at the surface. The bank-head will be built and permanently equipped this spring and hoisting engines erected. The angle of dip is 16°, the roof improves as the slope is continued and the coal is very regular.

Section of coal measures

'In company with Mr. Hugh Campbell, manager for the company by which McIsaac pond was converted into a harbour for the shipment of coal from two large seams at the old mines on Broad Cove river, I made sections of the measures exposed along the coast and in other parts of the district, and took exact observations of the exploratory and permanent workings on the various seams. I am also indebted for valuable information to Mr. Donald McLeod and others.

Chimney Corner.

'Of late years no mining has been done at Chimney Corner, although interesting developments have deen made, as pointed out to

me by Messrs. Neil P. McKay, William Y. McRae, James W. Mac-Kenzie, C.E., and others. Nova Scotia—*Cont.*

'As already stated in the report for 1882-84, Carboniferous rocks occupy most of the western shore of Cape Breton island along the Gulf of St. Lawrence from Cheticamp to the Strait of Canso; but only small portions of this belt, lying between Chimney Corner and Little Judique, a distance of thirty-eight miles, include Coal Measures; while in only four limited districts, at Chimney Corner, Broad Cove, Mabou and Port Hood has coal been mined, these districts being separated by upheavels and protrusions of underlying barren measures, as shown on the maps which accompany the report above mentioned.

'The coal seams all border on the shore and are not known to extend far inland. Both at Port Hood and Broad Cove the workings will be largely under the sea, and the question of the conditions under which the sea areas can be won becomes one of great importance. Workings under sea.

'Although at some points there is a great thickness of barren strata between the coal seams and the gypsum and limestone, in other places they are brought together, evidently by faults. Exposures even on the shore are not continuous, while inland they are few; nevertheless an attempt has been made to build up a connected section of the strata for comparison in different parts of the field and with those given in the report for 1882-84. Faults.

'Two drills owned by the government of Nova Scotia have been at work during the past autumn. One of these, a Davis calyx-drill, cutting a core of five inches diameter, is boring among the iron bearing rocks of the Nictaux and Torbrook district in Annapolis county. This drill, the invention of an Australian, is said to be very much cheaper to operate and more efficient than a diamond drill. The boring is effected by steel teeth and chilled shot and the makers claim that $1.17 worth of shot will do the work accomplised by $500 worth of black diamonds. Borings at Torbrook.

'The other, a diamond drill, has been set up at Pottle (Sawmill) lake, near North Sydney, to test the existence of a workable seam of coal reported in this vicinity. The borehole is now about 200 feet deep. The importance of such explorations, systematically conducted, cannot be too strongly insisted upon. At Pottle lake.

'A third drill, a calyx-drill of 1,000 feet capacity, cutting a five inch core, has been set up, by a private company, at the bridge over the South-west brook on Grand Lake road, about six miles from Sydney, to test the eastward extension of the Mullins or Carrell seam in workable form, and the western extension of the Tracy seam. As was stated in my recent report on the Sydney coal-field, the former is of workable size and good quality at Lingan basin, but has not been traced to the At Grand Lake road

Nova Scotia—*Cont.*

southward; while the latter, apparently workable from False Ba Beach to Cochran lake has not been proved to the westward.

Doctor Brook iron mines.

'Mention has already been made of the iron ores of the Arisaig district in Antigonish county; and particularly, in the Report of the Geological Survey for 1886, pages 26P, 27P and 117P, and sheet No. 33 of the Nova Scotia series of maps—of the occurrence of red hæmatite, of good quality, in large workable masses or beds, in the neighbourhood of Doctor brook. In 1893 and 1894 about 1,373 tons of ore were mined in this district by the Nova Scotia Steel Company, principally from a bed running in an easterly and westerly direction for about a mile between the main branch and the east branch of Doctor brook; it was carried over a pole-railway two miles and a half to a shipping-place at Arisaig pier. The dip of this bed is nearly vertical, but it was not followed to a greater depth than twenty-five feet. Assays of the ore, made by the company, yielded 46·62 per cent. metallic iron. (G. S. C. Report for 1897, pp. 98 and 108s).

'During the summer of 1900, further extensive developments were made on the surface both along the bed worked by the Nova Scotia Steel Company and on a belt apparently immediately south of and distinct from that bed. The openings, of which a cursory examination was made by me in company with Mr. P. S. Archibald, C. E., of Moncton, on November 21st, are outlined on a map prepared by Mr. Archibald, a copy of which is in the office of the Geological Survey. They show a most encouraging quantity of ore, in masses varying from 2 to 16 feet in width, situated on high ground capable of easy drainage to a much lower level without pumping. Samples collected from seventeen of these openings were given to Dr. Hoffmann for analysis.'

Nova Scotia Gold Fields.

Work by Mr. E. R. Faribault.

Mr. E. R. Faribault, spent the first part of the winter 1899-1900 in plotting the surveys made during the previous summer in the counties of Hants and Queens. A summary report was also written on this region, including a description of the gold districts of Renfrew, Mount Uniacke, South Uniacke, Upper Newport, Meander River and Ardoise, as well as some additional notes on recent developments made at the Dufferin mine in Halifax county.* The large-scale plans of the gold mining-districts of Renfrew and Mount Uniacke in the county of Hants, and that of Lawrencetown in the county of Halifax, were completed and prepared for publication. The plan of Lawrencetown is now published, as well as those of Renfrew and Mount Uniacke.

On February 15th, Mr. Faribault left for the Paris International

* Summary Report, Geol. Surv. Can., 1899, pp. 168 to 187.

Exhibition to superintend the installation of the Canadian mineral exhibit, and returned to Ottawa August 26th. This has been referred to at length on a preceding page.

From September 5th to 28th he was engaged in field-work in Nova Scotia, in making a further examination of the gold mining districts of the eastern part of the province, visiting Renfrew, Oldham, Waverley, Lake Catcha, Tangier, Mooseland, Moose River, Caribou, Beaver Dam, Dufferin Mines, Harrigan Cove, Ecum Secum, Goldenville, Wine Harbour, Cochran Hill, and Isaacs Harbour. Field work.

In regard to this work Mr. Faribault states that many interesting notes were gathered on the recent developments made, which will throw more light on the laws governing the zones of special enrichment in the veins. He writes :—

'Important mining developments have lately been made in many districts, notably at Waverley, Caribou, Dufferin Mine, Ecum Secum, Golderville, Wine Harbour and Isaacs Harbour; while new development works were being started at Renfrew, Mooseland and Harrigan Cove. Mining developments.

'At Renfrew, extremely rich quartz was being taken out on the Jubilee vein recently found to the east of the fault on the Colonial property. A crushing of 110 tons is reported to have given 2,700 ounces of gold, valued at some $53,000.

'The East Waverely property has recently been equipped with a thoroughly good mining plant, a large compressor and a modern eighty-stamp mill provided with eight Wilfley concentrating tables, the whole driven by an excellent water-power, enabling mining operations to be conducted at a very low cost.

'The recent cross-tunnels and drifts opened up at Ecum Secum mine have developed several very interesting saddle-shape veins on a double crumpling of the main anticlinal fold, and an important true fissure vein following the axis-plane of the local synclinal fold. These developments show most conclusively and in a very striking manner that the size and richness of the veins are altogether a result of the structure of the measures, and that they are well-defined and can be located.'

CHEMISTRY AND MINERALOGY.

Reporting on the work done in these branches of the Survey's operations, Dr. Hoffmann says :—'The work carried out in the chemical laboratory during the past year has, conformably with the practice of preceding years, been almost exclusively confined to the examination and analysis of such minerals, etc., etc., as were considered likely to prove of more or less economic value and importance. Briefly summarized it embraced : Chemistry and mineralogy.

Chemistry and mineralogy
Coal
Analyses.

'1. Analyses of fuels, including lignites, lignitic coals, coals, and anthracite, from the following localities:—Lignite from the upper and lower workings on Cliff creek, and from the upper and lower seams on Coal creek, in the Yukon district, North-west Territory. Lignitic coal, from Lewes river, about six miles above Rink rapid, also in the Yukon district. Coal, from Dunsinane, Kings county, New Brunswick; from a seam on the Stony Indian reserve, district of Alberta, North-west Territory; and from two seams on Collins gulch, Tulameen river, Yale district, British Columbia. Anthracite, from ten miles west of Dugdale station on the White Pass and Yukon railway, Yukon district, North-west Territory.

'2. Analyses of the following iron-ores:—Magnetite, from the townships of Litchfield and Sheen, Pontiac county, province of Quebec, and from a creek entering the Tulameen at Otter flat, Yale district, British Columbia. Specular iron from Cape Rouge, Inverness county, Nova Scotia. Siderite and limonite, from Hematite mountain, Michipicoten, Ontario; and bog iron-ore, from Chipman, Queens county, New Brunswick.

'3. Analyses, partial, of samples of copper-ore from localities in Joliette county, province of Quebec.

'4. Analyses, in regard to nickel content, of pyrrhotite from the township of Mattawatchan, Renfrew county, Ontario; and from Kyuquot, on the west coast of Vancouver Island, British Columbia.

Assays for gold and silver.

'5. Assays, for gold and silver, of samples of material from various localities in the districts of Cariboo and Cassiar, British Columbia, and from numerous localities in the Klondike area, in the Yukon district, as likewise from some localities on Great Slave lake, in the Mackenzie district, and others from Carleton county, in the province of New Brunswick.

'6. Analyses of building stones, that is to say, of a limestone from the fifth bed of Mr. Robillard's quarry, Ottawa front, township of Gloucester, Carleton county, and of a dolomite from the township of Ross, Renfrew county, in the province of Ontario; also the examination, in regard to its suitability for constructive purposes, of a sandstone from Prince Edward Island, and of another from near Dorchester, Westmoreland county, New Brunswick.

'7. Analyses, partial, of graphite from the township of Blythfield, Renfrew county, and from the townships of Bedford and South Canonto, Frontenac county, in the province of Ontario; and of disseminated graphite from Glendale, River Inhabitants, Inverness county, Nova Scotia.

'8. Analyses of natural waters—with the object of ascertaining their suitability for economic or technical purposes, or possible value from a medicinal point of view—from the undermentioned localities :—In the province of New Brunswick, from three springs on the Tobique river in Victoria county ; and from a spring near Plumwessep station on the Intercolonial Railway, in Kings county. In the province of Quebec, from a spring in Bay of Seven Islands, Saguenay county ; from a boring near St. Grégoire, Nicolet county ; from a well in St. Paul l'Ermite, L'Assomption county ; and from a spring at Ste. Rose, Laval county. In the province of Ontario, from a well on the property of Mr. Cole, township of Ramsay, Lanark county ; and from a well at Tilsonburg, township of Dereham, in Oxford county. In the province of British Columbia, from a spring near Discovery claim, three miles up McKee creek, east side of Atlin lake, and from another spring on the east shore of Atlin lake, ten miles south of Atlin ; also from a spring on Sharp point, on the west coast of Vancouver island. Chemistry and mineralogy—*Cont.*

'9. Analyses of several minerals not previously recognized as occuring in Canada, namely, of danalite, newberyite, schorlomite, struvite, uranophane, and wood-tin,—a variety of cassiterite (tin dioxide) ; all of which will be referred to in detail in my forthcoming report. Examinations have also been made of many minerals from localities where they were not previously known to occur, that is to say, of—altaite (lead telluride), from Little Nigger creek, East Kootenay district, British Columbia ; amazon stone, from islands at Paint hills, James bay, Ungava district ; barite or barytes, from the township of Huntley, Carleton county, Ontario ; danaite (a cobaltiferous variety of mispickel), from the township of Calumet, Pontiac county, province of Quebec ; epidote, from Walrus island, Paint hills, James bay, Ungava district ; erythrite (a hydrous arsenate of cobalt), from Bull river, East Kootenay district, British Columbia ; gmelinite, from Red mountain, West Kootenay district, British Columbia ; jamesonite (sulphantimonite of lead), from Kettle river, Yale district, British Columbia ; lepidolite (lithia mica), from the township of Wakefield, Ottawa county, province of Quebec ; magnesite (magnesium carbonate), from Pine creek and Indian Reserve, Atlin, Cassiar district, British Columbia ; marl, from the township of Stafford, Renfrew county, Ontario ; molybdenite, from island No. 12, Paint hills, James Bay, Ungava district, from the township of Brougham, Renfrew county, Ontario, and from Trail creek, West Kootenay district, British Columbia ; mountain leather, from the township of Economy, Colchester county, Nova Scotia ; sericite, Bonanza creek, Klondyke, Yukon district, North-west Territory ; silver, native, township of Lybster, district of Thunder Bay, Ontario ; sphalerite or zinc-blende, from the township of Bouchette, Ottawa county, province of Quebec ; and New minerals.

Chemistry and Mineralogy.

spodumene (a metasilicate of aluminium and lithium), from Walrus island, Paint hills, James bay, Ungava district.

Miscellaneous examinations.

'10. Miscellaneous examinations, comprising the examination of numerous samples of clay, in regard to their suitability for the manufacture of bricks—ordinary building bricks or fire bricks, or pottery, from localities in the provinces of Nova Scotia, New Brunswick, Quebec, Ontario, British Columbia, and the North-west Territory; of samples of ferruginous slates, iron-sands, iron-ochres, marls, carbonaceous shales, bituminous shales, and of a great variety of other material.

'In addition to the foregoing work, six hundred and sixty-three mineral specimens, have been examined and reported on. Of these, many were brought by visitors, the greater number, however, were received by mail or express from residents in various parts of the Dominion.

'The number of letters personally written—chiefly of the nature of reports, and embodying the results of the examination, analysis, or assay, as the case might be, of mineral specimens—amounted to two hundred and forty-one; and of those received, to eighty-nine.

'Messrs. R. A. A. Johnston and F. G. Wait, assistants in the laboratory, have, by their close and unremitting application to the work in hand, rendered most efficient service. The former has made many important mineral analyses, and, in addition to carrying out a somewhat lengthy series of gold and silver assays, also conducted a great variety of micellaneous examinations; whilst the latter, has made numerous analyses of natural waters, as likewise of iron ores, limestones, etc., and also carried out many miscellaneous examinations.

Collections made by Mr. Broadbent.

'In the work connected with the mineralogical section of the museum, I have been very ably assisted by Mr. R. L. Broadbent. In addition to the general museum work—embracing the labelling and cataloguing of all newly received specimens, and the maintaining of the collection generally in an orderly condition—he has, during the absence of Mr. Willimott, in Paris, made up twenty-seven collections of minerals (included in the list given beyond) for distribution to certain Canadian educational institutions, and also spent some seventeen days in the collection of material for the making up of further collections for similar use, visiting, for this purpose, the township of Ross, in the province of Ontario, and the townships of Hull, Litchfield, Buckingham, Grenville and Chatham, in the province of Quebec. Whilst thus engaged, he obtained :—

	Specimens.	Weight.	Chemistry and mineralogy *Cont.*
Albite	....	100 pounds.	
Barite	..	150 "	
Fluorite, green	156		
" purple	70		
Granite		100 "	
Graphite	..	75 "	
Jasper		150 "	
Limestone		150 "	
" (marble)		115 "	
Mica		90 "	
Microcline		115 "	
Monazite	8		
Porphyry	..	100 "	
Pyrite	27		
Quartz	...	125 "	
Sandstone		200 "	
Scapolite	130		
Serpentine	140		
Syenite		175 "	
Tourmaline	200		
Uraninite, with gummite	12		
Wollastonite	112		
Zinc-blende		300 "	
Miscellaneous	....	50 "	

Contributions to museum.

'The additions to the mineralogical and lithological section of the museum, during the past year, amounted to one hundred specimens of minerals and one hundred and seventy specimens of rocks, of which latter, thirty-one, from the Upper Stikine river, B.C. were collected by V. H. Dupont, C.E., fifty, from the south-east of Dease lake, and thirty-nine, from the Skeena river, B.C. by J. S. O'Dwyer, C.E. Of the additions in question, the following were :—

(*A.*) *Collected by members of the staff engaged in field work in connection with the Survey :—*

Barlow, Dr. A. E. :—

Magnetite from the township of Dungannon, Hastings county,

Bell, J. M., from Mackenzie district, N.W.T.—

a. Siderite, from the south shore of Dease bay, Great Bear lake.

b. Hematite, from Rocher Rouge, MacTavish bay, east side of Great Bear lake.

c. Specular iron, from Echo bay, Great Bear lake.

d. Micaceous iron-schist, from Les isles du Large, Great Slave lake.

e. Hydromagnesite, from the south shore of Dease bay, some thirty miles S.W. of Fort Confidence, Great Bear lake.

Brock, R. W. :—

Molybdenite from the Giant claim, Rossland, West Kootenay district, B.C.

Contributions to museum *Cont.*

McConnell, R. G., from Yukon district, N.W.T. :—

a. Lignite from Rock creek, Klondike river.

b. Lignite from Cliff creek, Yukon river.

c. Anthracite from about ten miles west of Dugdale station, White pass and Yukon railway.

d. Bornite and chalcopyrite from the Arctic Chief claim, White Horse Copper Belt, White Horse, Lewes river.

e. Bornite and epidote, from the Springhill claim.

f. Magnetite from the Valerie claim.

g. Hematite (specular iron) Pueblo claim.

h. Bornite from the Copper King claim.

i. Bornite from the Anaconda claim.

j. Bornite from the Carlisle claim.

k. Bornite from the Rabbits-foot claim.

l. Auriferous gravel, from Gold hill, Bonanza creek, and Sulphur creek, Klondike Gold Fields.

McEvoy, J. :—

a. Crystals of Andradite from six miles east of Crows Nest lake, district of Alberta, N.W.T.

b. Crystals of Almandite (altered), from the same locality.

McInnes, Wm. :—

a. Native silver, argentite and sphalerite from the West End mine, Silver mountain, township of Lybster, district of Thunder bay, O.

b. Fluorite, calcite, amethystine quartz, sphalerite and pyrite, from the Star mine, township of Strange, district of Thunder bay, O.

c. Fluorite, quartz, and calcite, with pyrite, from the Gopher mine, township of Strange, district of Thunder bay, O.

d. Magnetite from three miles north of the west line of the township of Strange, district of Thunder bay, O.

e. Magnetite from half a mile west of Whitefish station, P. A. D & W. railway, township of Strange, district of Thunder bay, O.

f. Fifty rock specimens from the Thunder Bay and Rainy River districts, O.

(*B.*) *Received as presentations*:—

Craig, B. A. C., Canada Corundum Company, Toronto, O. :—

Ten samples of dressed corundum.

Contributions to museum—*Cont.*

Currie, T. W., Topographical Surveys Branch, Ottawa, O.:—

a. Carborundum (carbide of silicon) crystallized, 2 specimens.

b. Graphite, skeleton, after carborundum, the silicate having been eliminated.

c. Silicon, skeleton, after carborundum, the carbon having been eliminated.

De Wolf, Geo., Vancouver, B.C. :—

a. Coal from Collins gulch, Tulameen river, Yale district, B.C.

b. Gypsum from the Salmon river, Grande Prairie, Yale district, B.C.

Harrison, H. H., Halifax, N.S. :—

Galena from Faribault or L'Abîme brook, Cheticamp river, Inverness county, N.S.

Harrison, J. E., Madoc, O. :—

Talc from lot 14, con. XIV., Huntingdon, Hastings county, O.

Haycock, E. B., Ottawa, O. :—

Molybdenite from lot 15, con. X., Bagot, Renfrew county, O.

Kingston, Paul, Tichborne, O. :—

Graphite from lot 22, con. II., South Cannonto, Frontenac county, O.

Kuntsen, M., Salesund, Norway, per R. L. Broadbent :—

Model of a gold nugget from claim 36, Eldorado creek, Klondike Gold Fields, Yukon district, N.W.T.

McLellan, Allan, Ottawa, O. :—

Crystal of iron-pyrites from Elizabethtown, Leeds county, O.

Moffatt, J., Parry Sound, O. :—

Muscovite from lot 2, con. II. of Ferguson, district of Parry Sound, O.

Pearson, W., Paris :—

Bornite from about eight miles W. of White Horse rapids, Lewes river, Yukon district, N.W.T.

Pushie, Joseph, Malignant Cove, Antigonish county, N. S. :—

Chalcocite from a point on the shore of Northumberland strait, Antigonish county, N. S.

Ritchie, R. Mc., Bryson, Q. :—

Pyrrhotite from Calumet island, Pontiac county, Q.

Contributions to Museum. *Cont.*

Ross, Thomas, Little Rideau, O. :—

Celestite from the Little Rideau river, Hawkesbury, Prescott county, O.

Shirly, F. S., Glen Almond, Q. :—

Phlogopite (exteriorily altered to pinite) from lot 6, range III. of Derry, Ottawa county, Q.

Smith, E., Prescott, O.

Galena (crystals) from lot 18, con. VIII., Bedford, Frontenac county, O.

Soues, F., Clinton, B.C. :—

a. Native gold and native platinum, from the Ward claim, Horsefly Gold Mining Co., Horsefly river, Cariboo district, B.C.

b. Siliceous tuff, from Cadwallader creek, Bridge river, Lillooet district, B.C.

c. Claystone from about four miles north of Clinton, Lillooet district, B.C.

d. Tertiary sandstone from about four miles north of Clinton, Lillooet district, B.C.

e. Concretions of arenaceous claystone from about four miles north of Clinton, Lillooet district, B.C.

f. Shell of 'Pecten caurinas', found under a three-foot layer of gravel, at a point exactly opposite Day Bar, on the Fraser river, and about eight miles north of Lillooet, B.C.

Thompson, W., Portage du Fort, Q. :—

Magnetite (group of crystals), from the township of Ross, Renfrew County, O.

Winans, Bush, Glen Almond, Q., per R. L. Broadbent :—

Fluorite and quartz (crystals) from the township of Derry, Ottawa county, Q.

Educational collections supplied.

'Collections of minerals occurring in Canada, have also been made up and sent to various educational institutions, of which the following is a list :—

1. Dorchester High School, Dorchester, N.B.		Consisting of	100 specimens.
2. Natural History and Antiquarian Society of P.E. Island, Charlottetown, P.E.I.	"	100	"
3. County Academy, Liverpool, N.S.	"	100	"
4. High School, Picton, O.	"	100	"
5. High School, Vankleek Hill, O.		100	"
6. High School, Dunnville, O.	"	100	"
7. Collegiate Institute, Orillia, O.	"	100	"
8. High School, Mahone Bay, N.S.		100	"

9. Manitoba College of Pharmacy, Winnipeg, Man.	Consisting of	100	specimens	Educational collections—*Cont.*
10. Public School, Cody's Station, N.B	"	75	"	
11. Public School, Port Perry, N.S	"	75	"	
12. Collegiate Institute, Clinton, O	"	75	"	
13. Public School, Arragance Ridge, N.B	"	75	"	
14. Public School, Inkerman, O	"	75	"	
15. St. Louis de Gonzague Academy, Montreal, Q	"	75	"	
16. Public School, Thornetown, N.B	"	75	"	
17. St. Roche Convent, Quebec, Q	"	75		
18. College de Longueuil, Longueuil, Q	"	75	"	
19. Public School, Kempt Shore, N.S	"	75	"	
20. High School, Bradford, O	"	100	"	
21. Public School, Caraquet, N.B	"	75	"	
22. Superior School, Maryville, N.B	"	100		
23. Convent of the Sacred Heart, Halifax, N.S	"	75	"	
24. Balaclava Street School, St. Thomas, O	"	75	"	
25. Wellington Street School, St. Thomas, O	"	75	"	
26. High School, Port Perry, O	"	100	"	
27. High School, Sackville, N.B	"	100	"	
28. High School, Dutton, O	"	100	"	
29. Christian Brothers School, Laprairie, Q	"	75	"	
30. Superior School, Port Elgin, N.B	"	100	"	
31. Superior School, Hartland, N.B	"	100	"	
32. Westmount Academy, Westmount, Q	"	100	"	
33. Notre Dame Convent, Charlottetown, P.E.I	"	75		
34. St. Dunstan's College, Charlottetown, P.E.I	"	100		
35. Noel Graded School, Noel, Hants Co., N.S	"	75		
36. Windsor Academy, Windsor, N.S	"	100	"	
37. Lacombe Public School, Lacombe, Alta., N.W.T.	"	75	"	
38. Convent of L'Assomption, L'Assomption, Q	"	75	"	
39. Hotel Dieu School, Upper Bazile, Madawaska, Q.	"	75		
40. Public School, Parleeville, N.B	"	75	"	
41. Sisters of Congregration of Notre Dame, New Glasgow, N.S	"	75		
42. Leonardsville Public School, Deer Island, N.B	"	75	"	
43. Public School, Weymouth Bridge, N.S	"	75		
44. Grafton Advanced School, Grafton, N.B	"	75		
45. Public School, Trenton, Pictou Co., N.S	"	75		
46. Borden Street School, Toronto, O	"	75		
47. Public School, Summerville, N.S	"	75		
48. Victoria School, St. John, N.B	"	75		
49. Public School, Bear River, N.S	"	75		

'Three collections of fifty specimens each have also been prepared and forwarded to the Canadian Government Agency in Glasgow.

'Of the foregoing, the first twenty-five were made up by Mr. C. W. Willimott, and the remainder by Mr. Broadbent.

As explained on a previous page, the greater part of Mr. Willimott's time during the first half of the year was taken up in connection with preparations for the Paris Exhibition, and in the unpacking and installation of specimens in Paris.

MINERAL STATISTICS AND MINES.

Mineral statistics.

Of the work of this section Mr. E. D. Ingall reports as follows:—

'The regular functions of the section have been performed by the staff during the year.

'Our information regarding the economic mineral deposits of the country has been added to, including data as to discovery and development, as well as the statistics of the annual realization of the Dominion's income from these sources. This information has been added to our permanent records for purposes of reference and much of it is also embodied in the report of the section constituting part S of the Annual Report of the Survey.

'The preliminary summary statistical statement of the mineral output of Canada was ready February 27th, 1900, the fuller data not being available until much later in the year, the full report could not be completed till November 29th, 1900.

'Apart from the completion of the annual report much information was, as in the past, given in answer to inquiries. The collecting of data for this purpose constitutes a considerable factor in the work of the section. A very considerable amount of extra work also devolved upon the staff in connection with the issuing by the department of a descriptive catalogue of the mineral exhibit sent to the Paris exhibition.

Visits to mines.

'During the summer Mr. Denis and myself visited the magnetite deposits in the vicinity of Ottawa and in the district between Kingston and Pembroke, and made magnetic observations with the dip needle and dial compass at several points, bringing up to date also our knowledge of operations in those districts.'

PALÆONTOLOGY AND ZOOLOGY.

The following is Dr. J. F. Whiteaves' report upon work accomplished by himself or under his direction:—

Work by Dr. J. F. Whiteaves.

'The fourth part of the first volume of *Mesozoic Fossils* was published in November, 1900. It consists of forty-six large octavo pages of letter press, illustrated by two woodcuts in the text and by seven full-page plates.

'A description of an apparently new species of *Unio*, from the Wellington collieries at Nanaimo, B.C., that had been forwarded for examination by the authorities of the Provincial Museum at Victoria, has been written and communicated to the *Ottawa Naturalist*.

'In the *Geological Magazine* for September and October, 1900, five new species of long-tailed decapod crustacea, from the Cretaceous rocks

of Comox, Hornby island (B. C.), and Alberta, have been described and figured by Dr. Henry Woodward, and an additional species, from Comox, and Hornby island, that had been previously described by the writer, but not figured, is fully illustrated. The types of each of these species are in the museum of the Survey. Palæontology and zoology - *Cont.*

'At various times during the year, seven small collections of fossils, mostly from the Corniferous limestone of Ontario, have been sent to the department for identification. The species contained in these collections have been determined, as far as practicable, and labelled, and the collections returned. Information about numerous single specimens of fossils has also been given, either by letter or verbally.

'Considerable progress has been made with the manuscript of the Catalogue of the Marine Invertebrata of Eastern Canada, which was commenced in the fall of 1899. About 345 foolscap pages of this catalogue have now been written, though some of these will yet require a little revision. Of these, 45 pages are devoted to the Protozoa, Sponges and Cœlenterata, 15 to the Echinodermata, 45 to the Annelida, 29 to the Polyzoa, 136 to the Mollusca, 65 to the Crustacea, and 10 to the Tracheata. The introduction, which is intended to consist of a brief synopsis of the progress of zoological explorations by the dredge or otherwise, in the Gulf of St. Lawrence and Maritime provinces, from 1852 to the present date,—and the part specially referring to the Tunicata, have yet to be written. The manuscript that has been written so far has necessitated a large number of verifications of references, and some correspondence with naturalists in the United States and Europe. In this connection it may be mentioned that Professor Verrill, of Yale University, who has recently been making a study of the difficult molluscan genus *Bela*, has kindly named all the Canadian species of that genus, whether from the Atlantic or the Pacific. Catalogue of marine invertebrata.

'The publication of the first part of Professor Macoun's Catalogue of Canadian Birds has directed attention to some deficiencies in the Survey's zoological collection. During the past year efforts have been made to supply these deficiencies, and incomplete sets of the eggs of about thirty species have been gradually replaced by full and complete ones. Among the latter are a full set each of the eggs of Wilson's Snipe and the Long-billed Curlew, from Assiniboia: of the Prairie Hen, from Manitoba; of the Sharp-tailed Grouse, from Alberta; of the Turkey Vulture, from Assiniboia; of the American Goshawk, from Alberta; of the Screech Owl, from Toronto; and Short-eared Owl from Assiniboia; of the Rufous Hummingbird, from Banff; and Lark Sparrow, from Toronto. Fine photographs of the nesting places of several species of Canadian birds have also been acquired, in exchange for similar prints from our own negatives. A collection of recent land and fresh-water shells from Washington, Ontario, and three species of Zoological collections.

Palæontology and Zoology.

Unionidæ from the neighbourhood of St. John, N.B., that had been sent for identification, have been named and returned to the senders.

Work by Dr. H. M. Ami.

'Dr. H. M. Ami says that the "greater part of his time during the past year has been devoted to office and museum work. Two weeks in July were spent in an examination of the Silurian formations in Antigonish county, Nova Scotia, and their inclosed faunas. A few days in August were employed in examining certain limestone quarries in Eastern Ontario with a view to determining the precise geological horizon and formation to which they belong. Considerable time was also spent in determining species of fossils from various horizons in the Palæozoic, as well as in making a revision of those from the Pleistocene, of the Ottawa valley."

"Some progress has been made in the preparation of a catalogue of Canadian fossils, and systematic tables of the succession of various geological formations are now being prepared as a basis for such a catalogue. A card catalogue of the geological formations and fossils of Canada and references thereto is greatly needed, and the commencement of such a catalogue has been made."

Specimens sent out for examination.

"With a view to obtaining all the information possible, from a palæontological standpoint, upon important geological questions as to the age and correlation of certain Palæozoic sediments in Nova Scotia, several collections were prepared by Dr. Ami during the past year, and submitted to the following gentlemen:—to Dr Henry Wood ward, F.R.S., Keeper of the Department of Geology at the British Museum, London,—a series of protolimuloid and other Crustaceans from the marine Carboniferous limestones of Kentville creek, and from Harrington river, Cumberland county, N.S.; to Dr. Wheelton Hind, F.R.S., of Roxeth House, Stoke-upon-Trent, England—various genera and species related to *Anthracomya* and *Naiadites* from numerous localities and horizons in Colchester, Pictou and Cumberland counties, also from Cape Breton; to Mr. Robert Kidston, F.R.S., of Stirling, Scotland—a series of Lycopodiaceous plants from the Carboniferous of Nova Scotia; to Messrs. Charles Schuchert and G. H. Girty, of the United States National Museum, Washington, D.C. — a series of marine invertebrates from numerous localities and horizons in the Carboniferous, also a small collection of fossils from the Torbrook sandstone formation of Annapolis county, N.S. From these gentlemen reports have been received giving important notes upon the age to which the various floras and faunas represented are to be assigned. The department is greatly indebted to these gentlemen for their valuable assistance."

Determination of fossils.

"Preliminary determinations of fossils from various localities comprised within the Three Rivers map-sheet, Quebec, by the writer contains classified lists of the fossils determined from numer-

ous collections made by officers of the Geological Survey from the counties of Joliette, Berthier and Maskinongé, on the north side of the St. Lawrence. Palæontology and zoology—*Cont.*

"Preliminary notes were prepared for Prof. L. W. Bailey on various collections of fossils from Carleton and York counties, New Brunswick, with a view of ascertaining the geological horizon indicated. The collections included Silurian strata (with *Monograptus* in abundance) from above Campbell's mill, Beccaguimic river, in Carleton county, N.B.; Silurian strata somewhat higher in the series and holding fragments of crinoids, etc., from Waterville in Southampton parish, York county, N.B.; and Lower Ordovician impure limestones from above Shaw's mill, Beccaguimic river, N.B.; on two collections of *Dictyonema* from near Benton village, Eel river. The latter at first seemed to indicate an horizon similar to the slates of the Kentville formation in Kings county, Nova Scotia, where *Dictyonema Websteri*, Dawson, is the characteristic fossil, in the altered slates of that formation referred to the Silurian system. Better material from the second collection enabled the affinities of the species to be much better understood, and when compared with specimens of *Dictyonema flabelliforme*, Eichwald, from the Upper Cambrian slate of Matane, Que., of Barachoix, in Cape Breton, and of Navy island near St. John, N.B., as well as with the figures and descriptions of this species according to Carl Wiman, there was scarcely any doubt left as to the identity of Eel river specimens with the Upper Cambrian species.

"Additional notes on a small but important collection of specimens from a black carboniferous altered shale from Springfield brook, five miles from Fredericton, N.B., collected by Mr. W. H. T. Reed, were prepared and transmitted to Prof. Bailey, to be incorporated in his report upon the geology of that portion of New Brunswick.

"Some time was also spent in a critical study of Mr. T. C. Weston's collections of Ordovician fossils from Quebec city, obtained in 1890, and a list was prepared of the species therein recognized. In response to special inquiries or requests for information, a number of short reports or memoranda have also been prepared from time to time during the year, but these it is unnecessary to specify in detail.

"Having received instruction to describe and illustrate the fauna of the Silurian formation at Arisaig, Nova Scotia, the writer has begun his task by arranging the collections of Arisaig fossils already in the possession of the Geological Survey Department into natural formational divisions, ascribing certain faunas and strata to certain formations. Through the kindness of Profs. Whitfield and Bickmore, of the American Museum of Natural History, New York, where many of the original types of Nova Scotia species are deposited, the trustees of Study of the Arisaig fauna.

Palæontology and zoology *Cont.*

that museum have generously consented to allow these types to be re-examined and if necessary refigured so as to ensure greater accuracy and critical comparison with the species represented in various other collections in the Ottawa museum to be examined. These latter include the series of Arisaig fossils now in the museum of the Geological Survey of Canada, the Weston collection of 1886, and other collections by the writer, made for the most part during the past summer when the strata were found to be divisible into four series in descending order, as follows :—

Proposed subdivisions of the section.

"*The Stonehouse formation*, consisting of red shales, holding a highly pelecypodous fauna, mudstones and interstratified ratified bands of limestone.

"*The Moydart formation*, consisting for the most part of light or greenish-white compact fine grained silicious limestone and shales holding cephalopoda, brachiopoda, vermes and trilobita, with occasional crinoidea and pelecypoda.

"*The McAdam formation*, consisting of very dark gray or almost black, carbonaceous and at times slightly calcareous, shales and mudstones, carrying a lamellibranchiata fauna. It also contains brachiopoda in thin lenticular sheets of limestone interstratified between the shales.

'*The Arisaig formation* consisting of light yellowish or buff weathering arenaceo-magnesian limestones, shales, etc., interstratified with bands of shale, etc. Corals, brachiopoda, bryozoa, trilobites and gasteropoda are prevalent types in this formation.

"These formations are based upon palæontological as well as lithological characteristics and appear to be less arbitrary than the divisions A, B, B', C, and C', D, of former writers.

"The "red stratum" is not a good dividing line, as the strata both above and below it are of the same origin and hold similar types of organisms.

Limestones in Eastern Ontario.

"In company with Dr. R. W. Ells, a number of the limestone quarries of eastern Ontario, were visited including those in the vicinity of L'Orignal, Hawkesbury, Vankleek Hill and Little Rideau, Butler's quarry, Murray's quarry, Huneau's quarry, Milner's quarry, Ross's quarry. At these we made a careful study of the formational characters of the various limestones examined so as to be able to correlate, separate or identify the different horizons represented. Some of the limestones examined belonged to the Trenton, others to the Birdseye and Black River, and others to the Chazy formation, whilst others formed transition strata between the last mentioned and the Calciferous formation.

Palæontology and zoology—Con.

"Considerable time was spent in sorting, classifying and naming various collections of Pleistocene fossils from the marine clays, sands, gravels and calcareous concretions obtained during the past few years by the staff and local collectors in the Ottawa valley. The clays were found to abound in foraminifera and several additions to the fauna of the marine Pleistocene deposits of this region were noted and placed on record. Messrs. Walker and Mortimer Odell, G. L. Burland and Harold Nelson, have contributed several interesting forms new to the Ottawa Pleistocene list.

Pleistocene fossils.

"Preliminary notes upon a number of collections of fossils by E. Le Roy, of McGill University, were prepared with a view of ascertaining the various geological formations and horizons represented in said collections. These were named as far as mode of preservation and condition of specimens allowed, and included an interesting series from Upper St. Hubert, Côte St. Michel, Outremont, the Annex and other localities around the city of Montreal.

"During the past year the following papers were written :—

Publications.

"On some Trenton (Ordovician) fossils from the light-gray limestones of Cumberland, Ontario, published in the *Ottawa Naturalist*, for January, 1900.

"On the subdivisions of the Carboniferous system in Eastern Canada, published in the *Transactions of the Nova Scotia Institute of Science*, for June, 1900.

"Notes bearing on the Devono-Carboniferous problem in Nova Scotia and New Brunswick.

"The Fossil Floras of the Pottsville formation published in the *Ottawa Naturalist*, for October, 1900.

"On the occurrence of a species of *Whittleseya* in the Riversdale formation (Eo-Carboniferous) of the Harrington river, Nova Scotia. published in the *Ottawa Naturalist* for August, 1900.

"Synopsis of the Geology of Canada, with special reference to the nomenclature of the various formations, read before the May meeting of the Royal Society of Canada, and now in the press.

"Progress of geological work in Canada during the year 1899, *Can. Record of Science*, for July, 1900.

"Bibliography of Sir J. William Dawson for the *American Geologist*, July, 1900, pp. 1-47.

"Brief reviews were prepared for the *Annales de Géographie*, of Paris, France, for *Bibliographia Geologica* of Brussels, Belgium, also for the *Geologische Centralblatt*, of Berlin, Germany, and

Publications and Geography, *Cont.*

abstracts of the various publications bearing upon the geology and geography of British North America during the year 1899 and 1900.

Examination of drillings.

"A number of drillings from various localities submitted to the department from time to time have been examined and information as to the formation represented in these bore-holes has been given to those interested. Suites of specimens of this kind have been examined from Stratford, Hepworth, Palmerston, Mt. Forest, Walkerton, Rockliffe Rifle Range and Gloucester, in Ontario, and from St. Paul l'Hermite, Turkish Baths artesian well, etc., in Quebec.

"Entries were also kept and records made of the ethnological and archæological collections obtained during the year."

Work by Mr. L. M. Lambe.

'Mr. L. M. Lambe reports that in the early part of the year, the report on recent marine sponges, referred to in last year's Summary as fairly under way, was finished. This report, descriptive of monaxonid, tetractinellid and calcareous sponges from our north-eastern waters, has been published in the Transactions of the Royal Society of Canada for this year, under the title *Sponges from the Coasts of North-eastern Canada and Greenland*, and consists of nineteen pages of text illustrated by six plates of figures. These sponges were placed in in Mr. Lambe's hands by Professor D'Arcy Thompson, of University College, Dundee, Scotland, who has since presented to this department an almost complete duplicate set of the species described or mentioned in the report, an addition to the already large and representative collection of Canadian sponges in the museum, that is of considerable scientific interest.

Publications.

'At later dates the following papers on recent sponges were published in the Ottawa Naturalist:—"*Description of a new species of Calcareous Sponge from Vancouver Island, B.C.*" "*Notes on Hudson Bay Sponges.*" "*A Catalogue of the recent Marine Sponges of Canada and Alaska.*"

Investigation of Cretaceous vertebrates.

'Having received instructions in April last to prepare a report on the vertebrate remains from the Cretaceous rocks of the Red Deer river, Alberta, collected by me during the summers of 1897 and 1898, my time has since been almost entirely devoted to a study of these remains, but more particularly to those of the Dinosaurs. A preliminary report on these collections, in which Chelonia and Crocodilia are represented, as well as Dinosauria, has already appeared in the Summary Report for 1898. The difficulty of arriving at a proper understanding of the generic and specific relationships of many of the bones to each other, and of their affinities, is enhanced by the very scattered state in which they were found. Fair progress has, however, been made in the elucidation of many of the above questions, a result attained with the co-operation of Professor Henry F. Osborn, of the American Museum

of Natural History, New York, who has consented to exercise a general supervision over this work as it proceeds. Considerable time has necessarily been spent in putting together and strengthening some of the larger specimens, that were in the condition in which they were brought in from the field, to allow of their being moved or handled for the purpose of study or illustration. A number of India-ink, shaded drawings, to be reproduced in the plates supplementing the report, have already been made. Palæontology and zoology—*Cont.*

'In connection with this work a week was spent by Mr. Lambe, in June last, in the department of Vertebrate Palæontology of the American Museum of Natural History in New York, where Professor Osborn afforded him every facility to study the collections and to familiarize himself with the methods employed there. Mr. Lambe also at this time paid short visits to Princeton and Yale universities, where, by the kindness of Professors W. B. Scott and C. E. Beecher, respectively, he saw much interesting vertebrate material.

'Some time has been devoted by Mr. Lambe to the final revision of his second report on fossil corals, which is now in the press. This report forms the second part of the fourth volume of *Contributions to Canadian Palæontology*; it concludes "A revision of the genera and species of Canadian Palæozoic Corals," and is descriptive of "The Madreporaria Aporosa and the Madreporaria Rugosa," the first part, published last year, having for its scope, a description of the "Madreporaria Perforata and the Alcyonaria."

'A number of fossil corals, from the Trenton rocks of Baffin Land, were named for Mr. Charles Schuchert, of the United States National Museum, Washington, D.C., who in return presented this Department with some of the duplicate specimens and a co-type of a new species, described by him.

'During the past summer Dr. G. F. Matthew continued his exploration of the Cambrian areas of Cape Breton, but was able to devote only a few weeks to this work. Work by Dr. G. F. Matthew in Cape Breton.

'Owing to this he gave himself chiefly to the study of the Etcheminian or Lower Cambrian, and the collection of its fossils. The purpose of this study was to note the succession of the species which occur in this group of beds, so that this knowledge may be available for determining the age of parallel beds elsewhere.

'He found a more complete succession of groups of strata in this series than was observed last year, and that the volcanic beds beneath are essentially a part of the series and contain similar fossils. Groups determine l.

'The slates and sandstones above the volcanic beds are divisible into three groups—the lower chiefly gray shales or slates, the middle chiefly

Contributions to Etcheminian. *Cont.*—

red with some gray, the upper chiefly gray with some reddish beds. The middle or red group, which is usually more firmly cemented and of coarser materials than the rest, is often liberally charged with diffused red oxide of iron. This has been seen to form layers rich in iron, or even thin seams of hæmatite, which have in several places been exploited for iron ore. This red member is present whenever the Etcheminian series has been found.

'While it can be shown that continuous changes took place in the Etcheminian faunas, there was such an incursion of new species at the base of the upper slates that these practically contain a new fauna, different from that which fills the layers of the lower and middle groups.

'As the fauna found last summer in shales in the volcanic rocks below the Etcheminian sediments does not differ more from that in the lower Etcheminian shales than this differs from the fauna in the upper shales, these volcanics may not be separated from the sedimentary system above.

Predominant elements of fauna.

Brachiopods and ostracods form the predominant element in the Etcheminian fauna. *Lingulella*, *Obolus* and *Leptobolus* are the three most noticeable genera of brachiopods in this fauna, though *Acrotreta* and a new genus, *Acrothyra*, are common. The latter is specially characteristic of the Etcheminian beds, and *Acrotheca* has been found only in the upper fauna. There are two peculiar genera of ostracods in the Cape Breton Etcheminian.

Evidence of currents.

'Evidence was obtained of the existence of a north-east current over one district where the Etcheminian beds are found, for a great part of Etcheminian time, but the observations made were not sufficiently extensive to determine whether this current was a tidal one, or a marine current setting continuously in the direction indicated.

'Great differences were observed in the thickness of the Etcheminian rocks in different areas, hence the determination of the proper chronological succession in this group is important.

'Some problems of this investigation are still unsolved, *e. g.*, the placing of some faunal bands and the examination of the eastern and southern sides of the Mira basin.'

The following is a list of specimens collected by or received from officers of the staff during the year 1900:—

Dr. G. M. Dawson:—

Wing of fossil insect, "probably one of the planipennian neuroptera," according to Dr. S. H. Scudder, from the Kootanie group of Cretaceous rocks of the Crows Nest Pass.

Contributions to museum—*Cont.*

Dr. G. M. Dawson and James McEvoy :—

Eighteen specimens of fossil plants from the coal-bearing rocks of the Kootanie series at Michel Station, B.C., on the Crow's Nest branch of the Canadian Pacific railway.

Professor L. W. Bailey :—

About fifty specimens of black, indurated, fossiliferous slate, holding fragments of *Dictyonema flabelliforme*, Eichwald, from near Benton, Eel river, N.B.

About twenty specimens of black graptolitic (*Monograptus*) shales from the Silurian of York county, above Campbell's mill ; and about ten specimens of dark-gray and black impure limestone, from above Shaw's mill, both on the Beccaguimic River, N.B.

Ten specimens from a light-gray altered crinoidal limestone, probably of Silurian age, from Waterville, York Co., N.B.

R. G. McConnell :—

Portion of skull of extinct bison, possibly *B. laticornis*, Leidy, found in a layer of 'muck' about fifteen feet below the surface of the ground on claim No. 17, Gold Run creek, Klondike district, Yukon.

Dr. H. M. Ami :—

About 750 Silurian fossils from the Arisaig coast, Antigonish Co., N.S.

Twenty-five fossils from the Lower Devonian rocks at McAra's brook, Antigonish Co., N.S. These are found to be remarkably similar to the Cornstone fossils of Herefordshire, England.

Collections of fossils from the Calciferous, Chazy, Trenton, Utica and Pleistocene formations of the Ottawa valley, including specimens from several limestone quarries in the neighbourhood of L'Orignal and Little Rideau, eastern Ontario.

James McEvoy :—

Twenty-six fossils from the Carboniferous rocks near Elk river, East Kootenay ; and twenty from the Kootanie series near Fernie, B.C.

The additions to the palæontological, zoological and ethnological collections from other sources during 1900, are as follows :—

By presentation :—

(A.—*Palæontology*).

U. S. National Museum, Washington, D.C. ; per Hon. C. D Walcott :—

Contributions to museum (Cont'd.)

Eight specimens of *Laotira cambria*, and five of *Brooksella alternata*, Walcott (two species of fossil Medusæ), from the Middle Cambrian of Alabama.

Eight specimens of *Beltina Danai*, Walcott, from the Algonkian of Montana.

U.S. National Museum, Washington, D.C. ; per Charles Schuchert:—

One specimen of *Plasmopora Lambi*, Schuchert, from the Trenton limestone at the head of Frobisher bay, Baffin Land ; and three specimens of *Protarea vetusta*, from the Cincinnati group (Hudson River) of Oxford, Ohio.

Colonel C. C. Grant, Hamilton, Ont :—

Forty-eight fossils, mostly sponges, from the Niagara formation near Hamilton.

Sixteen small parcels of fossils from the Niagara formation at Hamilton and Grimsby, and from the Cambro-Silurian (Hudson River) drift of Ontario.

J. A. Gray, Dorchester, N.B.:—

Fossil plant from the centre of a large boulder that was broken up on the ridge near the penitentiary quarry at Dorchester.

Dr. A. P. Coleman, Toronto :—

Two fossil corals from Brazeau, Alberta.

F. Soues, Clinton, B.C. :—

Six specimens of a small fossil bivalve shell (*Sphærium*) from Ward claim, one of the deep gravel beds on the Horsefly river, Caribou district, B.C.

H. S. Poole, Stellarton, N. S.:—

Specimen of *Stigmaria ficoides*, with the internal structure unusually well preserved, from the third seam, Albion mines, Stellarton.

W. J. Wilson, Otttawa :—

Leaf of willow or poplar, found in a calcareous nodule at Besserer's grove, near Ottawa, in 1899.

Contributions to Museum — *Cont.*

T. C. Weston, Ottawa :—

Fine specimen of a graptolite (*Tetragraptus approximatus*, Nicholson), from Point Lévis, P.Q. ; and small piece of limestone holding crinoidal fragments, from near Dufferin Terrace, Quebec.

(B.—*Zoology*).

Professor D'Arcy W. Thompson, Dundee, Scotland :—

Seventeen specimens of fifteen species of rare sponges, from the Gulf of St. Lawrence, Davis Strait, East Greenland, etc.

Professor G. T. Kennedy, Windsor, N.S. :—

Twelve specimens of four species of marine shells dredged in Minas Basin ; and one specimen of a recent brachiopod (*Terebratulina septentrionalis*) taken on a trawl line at Tiverton, Digby Co., N.S.

A. L. Garneau, Ottawa :—

Female, nest and set of twelve eggs of the Carolina Rail, the latter taken June 18, 1900, from the Mutchmor driving-track.

Captain W. Thorburn, Pine Lake, Alberta :—

Set of fourteen eggs of the Sharp-tailed Grouse (*Pediocœtes phasianellus*) and set of five eggs of the Bank Swallow (*Clivicola riparia*) from Knee Hill creek, Alberta.

G. G. Pearce, Toronto :—

Stuffed specimen of a nearly pure white snowy owl (*Nyctea nivea*) said to have been shot in Manitoba.

Walter Raine, Toronto :—

Egg of puffin (*Fratercula arctica*) from the Gannet islands, Labrador.

Set of four eggs of the Lark Sparrow (*Chondestes*) from Ontario, and a full set each of the eggs of 20 other species of North American birds.

Dr. C. Morse, Ottawa :—

Specimen of a sponge (*Chalina oculata*) from Black point, Liverpool harbour, N.S.

Master C. S. Morse, Ottawa :—

Specimen of the same sponge, from a ledge at Beach Meadows, Queens' county, N.S.

Harold F. Tufts, Wolfville, N.S.—

Set of six eggs of the Tree swallow (*Tachycineta bicolor*) from Wolfville.

Rev. G. W. Taylor, Nanaimo, B.C.:—

Two hexactinellid sponges (*Rhabdocalyptus Dawsoni* and *Aphrocallistes Whiteavesianus*) from Gabriola island, B.C., and two calcareous sponges (*Sycon protectum* and *Leucandra Taylori*) from Nanaimo, B.C.

S. W. Kain, St. John, N.B.:—

Three species of recent Unionidæ from New Brunswick.

J. W. Tyrrell, Hamilton, Ont. :—

One set each of the eggs of the Red-throated Diver, Long-tailed Duck, Spotted Sandpiper, Rock Ptarmigan, Rough-legged Buzzard, Horned Lark, American Magpie, and of two undetermined species of birds; from Artillery lake, N.E. of Great Slave lake.

(C.—*Archæology and Ethnology.*)

W. J. Rickie, Manotick :—

Rapier and stone implements, from near Manotick, Ont.

F. Dunn, Barry's Bay; Ont.:—

Two stone skin-scrapers, from Welshmans island, Barry's bay, Renfrew county; per Dr. A. E. Barlow.

A. Boyer, Ottawa :—

Jade adze, from the Tahltan summit, Teslin trail, B.C.

W. J. Wintemberg, Washington, Ont.:—

Stone chisel, three arrow heads, bone awl and six fragments of pottery, from Waterloo and Oxford counties, Ont.

F. Soues, Clinton, B.C. :—

Perforated shell (a valve of *Pecten carrinus*) found three feet below the surface, opposite Day bar, on the Fraser river; per Dr. G. C. Hoffmann.

Contributions to museum—

By exchange :—

Ornamented pipe-bowl and sixty-three fine arrow and spear heads of various shapes, from the Brant River reservation, Ontario; from F. Burnett, Nelson, B.C.; per R. W. Brock.

By purchase :—

Sets of the eggs of eleven species of Canadian birds; from Walter Raine, Toronto.

Four large carved house-posts from Old Nawhitti, Hope island, B.C., and other objects illustrative of the manners and customs of the Kwakiool Indians; per Dr. C. F. Newcombe, Victoria, B.C.

Stone pestles, chisels or scrapers, arrow- and spear-heads and bone implements from Hammond midden, B.C.; spear points, pestles, slate knives, scrapers, polishing and grinding stones, jade implements and ornaments, from Boundary bay midden, B.C., and a wooden implement from Chilliwack, B.C.—in all, sixty specimens; from C. Hill-Tout, Vancouver, B.C.

Earthenware pot, stone-pipe and other objects of Indian manufacture, from Bancroft, Ont.; from W. Mulcahey.

NATURAL HISTORY.

Report of the naturalist.

Professor John Macoun reports as follows on the work done by him and under his immediate direction during the past year :—

'Since the close of my last progress report, the work of the office has gone on as usual. During the year just closing I have had no assistance in the office, as Mr. James M. Macoun, in January and February was engaged on work for the Paris Exhibition, and since March has been in Paris in connection with the same work. While there he represented this Department at the meetings of the International Congress of Botanists and took part in several of the discussions. He also availed himself of his residence in Paris to visit all the principal herbaria and was enabled to see nearly all the botanical specimens collected in Canada by early French botanists. He returned in time to resume his regular duties at the opening of the new year.

Catalogue of birds.

'Besides the routine work of the office, I was enabled to publish the first part of my Catalogue of Canadian Birds, including the water birds, gallinaceous birds and pigeons, containing 218 pages. This work has been well received by ornithologists, both in Europe and

Natural History Catalogue.

America. This catalogue occupied my time up to June, when at your request I entered upon a Natural History examination of Algonquin Park, a reservation lately set apart in northern Ontario for the conservation of water and the preservation of game and fur-bearing animals.

Field work.

'Mr. William Spreadborough, who had been my field assistant for so many years, was engaged, and from May 25th until August 24th was employed in collecting specimens and making observations. Early in June I went into the field myself, and closed work on August 25th. The results of this examination will appear in another part of this summary.

'On my return from the field I found much correspondence awaiting me, and this with the naming of plants and the examination and determination of my own collections and the ticketing of plants of former years, has had to be attended to. Besides the 900 species of my own collecting, I have named collections from Prince Edward Island, New Brunswick, Quebec, Ontario, Rocky mountains and British Columbia, making in the aggregate fully 2,500 species.

'As you are aware, my most important work at present is the second part of the Bird Catalogue. This is well under way, and will likely reach the printer in spring. My knowledge of our fresh water fishes has increased so much that I would propose to take the cataloguing of these up after concluding the Bird Catalogue. Part VII. of the Catalogue of Canadian Plants, which is to include the lichens, liverworts and characae, is almost written, and will be ready for the printers in March.

Skins in museum.

'In this connection I may mention that we have at present, besides the birds and mammals mounted and in the cases, over 2,000 skins in cabinets, representing all the small mammals hitherto found in the Dominion, and all the smaller species of birds. I have recorded nearly 100 reptiles as occurring in the Dominion, and of these I have now named and preserved in alcohol almost eighty species. Nearly 100 species of fresh water fish were also preserved in alcohol and most of them named.

'Besides my own collections of plants made in Algonquin Park, we have received a fine collection from Banff, Alta., made by Mr. J. N. Sanson, and another by Mr. Gwillim, at Atlin, British Columbia. In the latter are a few species that are extremely interesting, as they, with those of last year, show that there is a group of species at Atlin we are still imperfectly acquainted with.

'From places external to Canada we have received several important additions to the herbarium by donation or exchange, among which are the following :— Natural History—*Cont.*

'Kew Herbarium, London, England. Presented by the director. A large box of plants, chiefly grasses, numbering over 500 species.

'United States National Museum. Presented by the botanist. Collections from Greenland, Baffin Land, and from South Dakota and other states of the Union, not less than 1,000 species. Specimens received.

'New York Botanical Garden. Presented by Mr. Britton. 741 species of plants, chiefly from the United States Yellowstone National Park.

'Natal Botanic Garden, South Africa. Presented by the director. 251 native species in exchange for Canadian specimens.

'Louisiana Plants. Carleton R. Ball. A set of 235 species given in exchange for Canadian plants.

'The following pages refer particularly to my work in the Algonquin Park :—

'Algonquin Park is an extensive tract of country about forty miles by thirty six in the southern part of the Nipissing district. The Parry Sound railway enters it near the south-eastern corner and passes through it in a north-westerly direction, leaving it a few miles east of Scotia Junction, where this railway crosses the branch of the Grand Trunk, which passes from Bracebridge to North Bay on Lake Nipissing. Its southern boundary is the Haliburton district and northerly it extends nearly to the Canadian Pacific railway as it passes west between Mattawa and North Bay. It may be characterized, in a general sense, by saying it is a land of lake and forest. A close examination of a large part of it would show that at least one third was lake and the remainder mostly fine old forest. Although elevated, it is in no sense mountainous, and, indeed, large portions cannot even be described as hilly. Between the lakes there is usually a gentle roll in the country, but the land seldom rises one hundred feet above local water levels. It is thus well adapted for a park reservation, and its value will become more apparent as the country to the south and east becomes more deforested than it is at present. Five considerable rivers have their sources in it, and descend in all directions except to the north-west, where the Amable du Fond has its source. This river drains the north-western part easterly and then flows northward to the Ottawa. Natural features of Algonquin Park.

'The Petawawa is the chief river within the park. Rising in the township of Butt, about the centre of the western side it unwaters a large series of lakes and lake-expansions and without much fall The Petawawa river.

Natural History—*Cont.*

gathers all their overflow in White Trout lake, a beautiful sheet of water about four miles long and three wide in the broadest part. This lake is in the centre of the park and is a reservoir of clear cold water that when well stocked with game fish will be a resort for fishermen and of very easy access. Leaving this lake the river flows easterly, passing through Red Pine lake, Burnt lake, Perley lake and Catfish lake, and descends into Cedar lake by a series of falls and rapids. Cedar lake is another reservoir, and besides the Petewawa, receives the Nipissing from the west and other small rivers from the north. Cedar lake is easily reached, being situated only twenty-five miles from Deux Rivières on the Canadian Pacific railway, and in time must be a great rendezvous for fishermen, as the canoe-routes ramifying from it as a centre extend to every part of the park. The lake itself is eight miles long, and with Cauchon lake, which is a river-like elongation at the western end it is not less than nine and a quarter miles long. Leaving Cedar lake the Petawawa descends to Trout lake and there leaves the park, entering the Ottawa river at Pembroke. The Muskoka river, by its various branches, drains the south-western side, and Canoe and Smoke lakes are the reservoirs into which the smaller streams and lakes discharge. The Madawaska rises in Source lake in the township of Peck, and in Cache lake finds its first reservoir, passing thence to Rocky lake and soon after leaves the park. Great Opeongo lake is the source of the Opeongo river, a branch of the Madawaska, and is itself the largest body of water within the park.

Lakes of Algonquin Park.

'It may be said that there are hundreds of lakes scattered through the park in every direction, and these with their connecting portages constitute both the summer and winter lines of communication. Many of these lakes are mere depressions below the general level and are not reservoirs except in a limited sense. All, however, contain pure water and with a few exceptions have rocky or sandy margins and good beaches at low water. This can be said of Great Opeongo lake, Cedar lake, Catfish lake (at present), Burnt lake, White Trout lake, Island lake, and many others. On the other hand, the beauty of Canoe lake is destroyed by the Lumber Company putting up a dam and keeping the water backed up permanently. Cache lake, where the park head-quarters are, and White's lake to the west of it, have also been permanently injured by the water being allowed to remain too long in the spring. The damming up of Cache lake is a real detriment and injury to the park, as the trees have been killed all around its shores and the former swamps have become stagnant marshes filled with dead trees. To this lake all sportsmen and summer visitors resort because it is easy of access by the Parry Sound railway. Here also is the residence of the superintendent, and so far as known at present the best lake for trout. During June and early July of the present year (1900) the water was so stagnant that many of the minnows were found to be affected by a

fungous growth. The water improved as the lake was allowed to approach its original level at a later date in the summer, but, unfortunately, and for no known reason, it is never allowed a free outflow. An outbreak of fever may be looked for at any time at Canoe lake and Cache lake, owing to the stagnant water. Island lake has a fine beach in many places, with rocky shores in others, and many lovely islands. The water is pure, there are no marshes nor dead trees, and the same remarks might be made of all those lakes characterized as reservoirs. Natural History—Cont.

'The forest within the park is still largely in a state of nature, except that the white pine has been cut out more or less completely everywhere. There are still quantities of uncut timber, however, on many limits, and many years will elapse before all of it can be removed. On Burnt lake, Perley lake and Catfish lake, young forests are growing up, and in the woods along these lakes the problem of re-foresting on nature's own plan is in progress. Around Catfish lake a young forest of pine, the trees ranging from six to fifteen inches in diameter and from fifty to one hundred feet high, has grown up, and the remains of an older growth show that poplar and white birch have been as plentiful fifty years ago as they are now along Perley lake, where the forest was evidently swept off less than twenty years ago. Any one looking at the forest along Perley lake would think that pine had ceased to grow there. Yet on the portages it was found that pine is in abundance everywhere, ranging from ten to fifteen years old, but much less in height than the poplar and birch. In the course of thirty years more, the pine will overtop the poplar and birch and other low growing trees, and smother them completely out as has occurred at Catfish lake, or will constitute a mixed forest of deciduous trees and conifers as is found everywhere in the old forest. Character of the forest.

'One burning of the forest never destroys the whole of the pine seeds, but if two or three burnings take place there is no hope of pine or conifers of any kind re-covering the soil. It is repeated fires in the same locality that makes replanting necessary. At present each government ranger is a fire guardian as well, and besides this each lumberman keeps a certain number of fire rangers on his limits, so that the park is amply guarded from extensive fires. Effect of forest fires.

'The bulk of the old forest consists of black and yellow birch (*Betula lenta* and B. *lutea*), though sugar maple is quite common on the more elevated and drier hills. Beech, ironwood and a little black oak are found mixed with the maple, and through the whole forest is found balsam fir and white spruce, but in no case were they found in groves. There are few swamps or bogs, and cedar, tamarack and black spruce are infrequent except close to lakes and rivers. Elm and black ash are occasionally met with, but they are comparatively Principal trees.

Natural History—*Cont.*

rare. Canoe birch is still found in remote situations capable of producing bark for canoes which are manufactured by the rangers.

Value of the park.

'The value of the forest as a covering for the soil and as a retainer of moisture cannot be overestimated. As a pulp producing region it is of little value, but its birch forests will yet be worth more than the pine.

'Perhaps after the conservation of the water in the soil, the next most useful effect of the park reservation is the protection of the larger mammals. Moose and the common or Virginian deer have already learned the value of protection, and hence they are found in greater numbers near the line of railway than in the remoter parts where man seldom comes. The reason for the common deer approaching the haunts of men is the safety to their young in the absence of wolves. This is seen by travellers and sportsmen who penetrate into the interior. For one deer seen in the heart of the park, half a dozen may be seen close to the railway.

Mammals.

'During July, both moose and deer are very easily approached and seem to take little heed of any one in a canoe. At this time they wade out into the lakes and ponds to feed on pond lily leaves which float on the surface, as well as on river weed (*Potamogeton*) which floats below the surface and has succulent roots. On one occasion in Otter Slide brook, we ran across a large bull moose that had waded out until he was up to his shoulders in the water. When we came upon him his head was all under water except the tips of his horns, and we paused while he began to raise his head from the water. We could not proceed as he blocked the way, but a slight noise made him shake the water from his eyes and ears, and it was amusing to see the expression of his eyes as he became alert. Still gazing upon us he walked rapidly to the shore, turned to have another look and disappeared in the forest.

'Beaver are multiplying fast and are building dams in new localities and backing up the water in many places. Within a short time they have built a dam over six feet high on the stream discharging into Cache lake. By doing this they changed a marsh into a lake and now the centre of the marsh has become a floating island with deep water around it. In a few years these animals, if properly protected, will become a large source of revenue, as their numbers will have to be kept within proper limits.

'Mink, fisher and martin are in more or less abundance and will also increase as time passes and wolves and foxes become fewer. Specimens were obtained of the smaller mammals and a detailed list of these will be found in the complete report when it is written.

'Mr. William Spreadborough, who acted as my assistant from the latter part of May, was instructed to make a careful examination of the birds breeding in the park. This was attended to all summer, with the result that eighty-six species are known to breed in the area. This list includes only our own work and does not pretend to be absolutely complete. Enough was learned, however, to throw much light on the breeding habits of many small birds that are usually believed to go much farther north at the breeding season. Natural History—*Con.* Birds.

'Game birds, with the exception of the Black Duck and the Ruffed Grouse (Partridge) and Canada Grouse are absent in the summer. Two of the river ducks (*Mergus Americanus*) and (*Lophodytes cucullatus* are common in the rivers, and all the lakes have colonies of Loons and the larger lakes of the Herring Gull.

'A useful enterprise was undertaken last year in having the river entering Cache lake seeded with wild rice. Owing to the backing up of the water in Cache lake this plant could not throw up its flowering stalks until late in August when it was too late (possibly) to ripen. When I first saw the plant on July 31st, I could not make out what it was. I asked Mr. Spreadborough to return to the place later, which he did on August 21st, and obtained a small panicle which settled the question. I then learned that the seed had been scattered in October 1899. By seeding the innumerable places throughout the reservation suitable for the growth of this plant, in a few years water-fowl and waders during the fall migration will come in multitudes to feed while many species of our best ducks will remain to breed. The absence of food is at present the cause of the scarcity of ducks. Wild rice.

'Mr. Spreadborough assiduously collected the smaller fishes in the various lakes so that we might be able to speak with some assurance regarding the future food supply for game fishes when these shall be planted in the lakes. He made a special trap, copied in part from those used by the Indians of British Columbia, and the results were excellent. Often it would not be in the water half an hour before it would be full of various species of small fish, with the young of some of the larger ones. A few small black bass were caught in Cache lake which had doubtless grown from the small fry placed in Source lake a short time ago. Fishes.

'A remarkable sameness was observed, in all the lakes, amongst the smaller fishes. The forms found in one lake or pond being more or less abundant in the next. There was, however, one remarkable exception. We had been told at Cache lake that there was a large chub in White Trout lake that was often eighteen inches long. When we reached the lower part of Otter Slide creek just before it enters the lake, and when the men were making the portage, I caught a

Natural History Coy.

number of these which proved to be Dace or Roach (*Semotilus bullaris*) and a species seemingly little known in Ontario, but found in the St. Lawrence at Lachine. Later we found it in the rapids in the Petawawa wherever we fished.

Food fishes.

'Owing to limited stay at various points, we did no lake fishing except in Cache lake, and Cranberry lake about one and a half miles from it. In these lakes two species of trout were common. One of them, however, was much more plentiful than the other. This species seems to have many names, but in reality is the Great Lake Trout *(Salmo namaycush)* which is found in all the large lakes lying to the northward from the Atlantic westward into the Rocky Mountains. The flesh of this fish taken in Cache lake was hard and firm the whole summer through, even in the hottest weather. The other species which was undoubtedly a brook trout *(Salvalinus fontinalis)* was found in both the lakes and their discharges, but especially in the latter. The lake form may differ in colouring from those taken in the rivers, but all have the vermiform markings which distinguish the Canadian brook trout from the char or trout of England. This fish was found in all the rivers, but July is not a suitable month for fly fishing, and hence our success in taking fish was rather poor. Owing to the comparatively short brooks that connect the larger lakes and rivers, brook trout are not plentiful except in the rivers as the Petawawa and the Madawaska. In Cache lake not more than five per cent of those caught are brook trout and in Cranberry lake about ten per cent.

'Of the coarser fish, there are several species, including two suckers, two catfish, perch, sunfish, eels and burbot, (*Lota maculosa*) and doubtless others. We saw no jack-fish, nor did we hear of any, and the same may be said of whitefish, which seem to be entirely absent. Twenty species of fishes were noted in all

Reptiles.

'In addition to the common frogs and toads found in most parts of Ontario, two species of salamanders and a newt were found. Snakes were rarely noted, only the dark coloured form, (*Eutænia sirtalis ordinata*) being collected.

Insects.

'A collection of the butterflies of the district showed nothing new or very interesting. Most of the forms, like the weeds along the railway, are evidently of recent introduction. The beetles were rare, or seldom observed, so that a large collection was not made. The species have yet to be determined.

Plants.

'A careful examination, as far as time would permit, was made into the whole flora of the park, the total number of species collected numbering 862. These were made up of 540 flowering plants and ferns, and 314 cryptogams, including mosses, liverworts, lichens

and a few leaf fungi. The trees, shrubs and herbaceous plants were simply those of the northern Ontario forest and produced few novelties. Natural History—

'The climatic conditions under which our forests develop themselves in a state of nature were shown in the park just as I had observed them in Nova Scotia and Quebec. Certain trees require a saturated atmosphere and hence prefer the lower levels, where coolness and moisture are to be found in such northern districts. The sugar maple, on the other hand, as we leave the lower plain of the St. Lawrence going north, begins to ascend the hills, and this it does until, when we reach its northern limit it is found on the highest hills facing the south. On account of the appearance of the forest, I thought the altitude given for the park was too high and after investigation found it was under 1,500 feet, instead of 2,000, as generally believed. Effect of climatic conditions.

'The effects of the passage of the railway and the cutting of lumber roads through the park, were well illustrated by the introduction of species of plants that are found as weeds in the open spaces and around dwellings. These have been followed by a few species of birds and a number of butterflies, so that every year greater changes will be observed, and when the lakes have been stocked with food fishes, the denizens of both land and water will change so much that in twenty years hence the present conditions will not be recognizable.

'A scientific aspect of the examination was the discovery of a few plants which I predicted many years ago would yet be found on the Ottawa. One of these, the three toothed cinquefoil (*Potentilla tridentata*), was found on a rocky point on Cache lake, thus connecting the Lower St. Lawrence botanically with Lake Superior. The cryptogamic flora, as might have been anticipated, produced the most novelties and a number of mosses new to science or to Canada, were detected.

'In forest regions where cultivation has not made inroads there are two series of plants. The first is the spring flora, the second is that of July and August. Distinct from the forest flora is the aquatic flora which reaches its fullest development in July. On account of these changes of habitat and time of development, the inexperienced collector only gets one series of plants, and these being chiefly river bottom plants are not the characteristic species of the country examined but only of the lowlands generally. The characteristic plants of a region are its forest flora. These exemplify the climatic conditions and constitute a very true index of the climate. Character of flora.

'In conclusion, I wish to thank Mr. J. W. Bartlett, superintendent of Algonquin Park; Mr. T. O'Leary, chief ranger, and Mr. J. Simpson, O. L. S. engineer, for their assistance and attention while I was engaged in the examination of the park.'

Natural History Museum.

Dr. James Fletcher, F.R.S.C., Entomologist and Botanist to the Experimental Farm, as honorary curator of the entomological collections in the museum of this Department, furnishes the following report:—

'I have the honour to report that the entomological collections are in good condition. The only additions which have been made during the past two years, by members of the staff of the Geological Survey, have been collected by Professor John Macoun and Dr. Robert Bell. Prof. Macoun's collections were (1) on Sable island in the summer of 1899. This collection was interesting on account of the locality, but the species of insects were practically the same as would be found on the mainland. Two interesting additions, however, were made to the collection, *Ommatostola lintneri*, Grt., and an Argynnis of the Aphrodite group, possibly referable to that species, but showing remarkable variations in marks and coloration. (2) A general collection made by Prof. Macoun in the Algonquin Park in the summer of 1900. This collection was chiefly of diurnal lepidoptera and contained 18 species of these insects. I was rather surprised to find that all of these species were the same as occur at Ottawa, the rarest being *Argynnis Triclaris* and *Colias Interior*. There were a few dragon-flies and moths, but nothing of any special rarity.

'Dr. Bell's collection was made at Great Slave lake in July and August, 1899, and consisted of three species of butterflies and four of moths. These were all of interest on account of the locality, although none of them were rare, the only addition to the collection was *Plusia U-aureum*.

'I would again ask you to urge upon the members of the staff, the value to the Museum of collections of insects, however small these may be, when exact dates and localities are given, and if each party would bring back only half a dozen specimens, valuable additions would doubtless be made to the collection. Prof. Macoun has contributed several important facts to our knowledge of the entomological fauna of Canada. One of the new species discovered by him at Nipigon some years ago, *Chionobas Macounii*, is one of the most interesting butterflies we have in the Dominion. It belongs to a distinctly Pacific Coast type of a genus which occurs all over the world, but differs from all known species by the total absence of the conspicuous sexual band in the males of this genus.

'Owing to the remarkable discoveries which have lately been made demonstrating the agency of mosquitoes belonging to the genus *Anopheles* in the dissemination of malaria, yellow fever and other diseases, I have thought it well to place in the museum a small collection of

mosquitoes. These I trust will be of interest and will be added to from time to time as occasion occurs.' Natural History Museum.

Maps.

Mr. C. O. Senécal, geographer and chief draughtsman, reports as follows on the mapping-work of the past year :— Report of Geographer.

'The assignment of the work has been as in previous years, the staff remaining practically unchanged. The ordinary routine work of laying down projections, correcting and revising engravers' proofs of maps, preparing memoranda on various subjects related to map-work, etc., has been attended to. Some time has been spent on a new edition of the List of Publications and in sending out instruments for repairs.

'During the year, Mr. L. N. Richard was mainly occupied with the compilation of the northern portion of the map of Hudson Strait and Ungava Bay, making afterwards a tracing of the same for the engraver. Additions to the map of Ottawa city and vicinity were made by him from surveys carried out during the past summer. He also revised and traced for the engraver, the Haliburton sheet, No. 118 of the Ontario series, and reduced latitude observations for the map of Lake Nipigon.

'Mr. W. J. Wilson has completed the compilation of the Manitou sheet, No. 4 Western Ontario; revised the Grenville sheet, No. 121 Ontario and Quebec, and reduced Mr. A. P. Low's survey of the east coast of Hudson bay to a scale of twenty-five miles to one inch. On July 27th, he was detached to accompany Dr. R. Bell in the field, and returned on November 6th. He has since been engaged in the revision of the map of Ottawa city and vicinity, and in plotting his own field-work.

'A preliminary map of the Klondike gold-fields was compiled by Mr. J. F. E. Johnston, who again accompanied Mr. R. G. McConnell in the field during the past season.

'Mr. J. Keele has completed the compilation of the Haliburton sheet, No. 118 of the Ontario series, and the map of the district near Bancroft, Ontario, and left for the field to assist Mr. J. McEvoy in the Crows Nest coal-fields. Since his return he has been engaged in the compilation of sheets 119 and 122, Ontario and Quebec.

'Mr. O. E. Prud'homme, besides attending to the usual distribution of maps held for sale, has drawn the following maps for the engraver, viz.: —Lawrencetown sheet, No. 53, Nova Scotia ; plans of gold districts of Lawrencetown, Renfrew and Mount Uniacke, Nova Scotia, and part of the Grenville sheet, No. 121, Ontario and Quebec. He has been employed on several compilations, and has also spent some time in tra-

Maps. cing railway plans at the Department of Railways and Canals, for office use.

'Mr. H. Lefebvre has been employed on the compilation of the Lake Nipigon map. Additions to the Nottaway River map, from recent provincial surveys, were made by him and a tracing of the same prepared for the engraver. He has also drawn for zinc-etching reproduction a series of diagrams showing the mineral production of Canada, and attended to the cataloguing of maps and plans, etc.

'Mr. W. H. Boyd, had been a short time on general draughting work, when he was sent as assistant to Mr. J. C. Gwillim, in the Atlin gold-fields. He returned to this office on October 22nd, and has since prepared township plans and road surveys for the compilation of sheet Nos. 119 and 122, Ontario and Quebec. He is now engaged in plotting his field-work.

'The engraving of the western sheet of the Dominion map, has been completed and transferred and corrected. The geologically coloured copy, which was prepared under the immediate supervision of the Director, was forwarded to the Queen's Printer on August 27th. The engraving of the eastern sheet is approaching completion.

'A preliminary geological and topographical map of Atlin gold-fields has also been drawn for reproduction by photo-lithography, and a series of index-maps showing the areas covered by various map-sheets, is in course of preparation.

'In January, I was appointed a member of the Geographic Board of Canada with Dr. R. Bell and Mr. D. B. Dowling, to represent the Geological Survey. Eleven meetings were attended and six lists of nearly 1,500 place-names covering maps in course of preparation, have been submitted and discussed. The action of the Board being restricted to names of features having greater geographical importance, names of minor features, as well as a large number of duplicated or otherwise objectionable names, were not passed upon. In this respect, it has not been deemed advisable to abide entirely by the decisions of the Board, and omit all such names from our maps, on account of necessary references in geological reports.

'During the past year, twelve new maps and plans have been published; there are at present, eighteen maps in the engraver's hands or in press, and about fifty other maps and plans at various stages of progress.

'Sheets 42 to 48, and 56 to 58,—ten sheets of the Nova Scotia series which have been engraved—are still held over, pending the final decision on certain geological points occuring in the area covered by them.

'An enumeration of the maps published during the year, or in course of preparation, is appended herewith:—

	Maps published.	Area in square miles
677	Relief map of Canada and the United States—Scale 250 miles to 1 inch.	
688	Yukon—Map of Klondike Gold-fields, (Preliminary edition.)—Scale 2 miles to 1 inch	1,432
676	British Columbia and Alberta—Yellowhead Pass route from Edmonton to Tête-Jaune Cache—Scale 8 miles to 1 inch.	
626	Ontario—Map showing the occurrences of iron ore and other minerals in portions of the counties of Frontenac, Lanark, Leeds and Renfrew—Scale 2 miles to 1 inch	1,700
681	Ontario—Sketch-map of oil-areas in Lambton county—Scale 4 miles to 1 inch.	
682	Ontario—Sketch-map of gas-field in Essex county—Scale 4 miles to 1 inch.	
683	Ontario—Sketch-map of gas-field in Welland county—Scale 4 miles to 1 inch.	
699	Ungava and Franklin—Map of Hudson Strait and Ungava Bay—Scale 25 miles to 1 inch.	
696	New Brunswick—Sheet No. 2, S.W.—Surface Geology—Scale 4 miles to 1 inch	3,456
697	New Brunswick—Sheet No. 1, N.W.—Surface Geology—Scale 4 miles to 1 inch	3,456
666	Nova Scotia—Lawrencetown Gold District—Scale 500 feet to 1 inch.	
701	" " —Renfrew Gold District—Scale 500 feet to 1 inch.	

Maps, engraving or in press.

	Dominion of Canada, 2 sheets, each 28 inches by 34 inches. Scale 50 miles to 1 inch	3,500,000
663	British Columbia—West Kootenay sheet—Scale 4 miles to 1 inch	6,40
711	British Columbia—Map of Atlin Gold-fields—(Preliminary edition)—Scale 6 miles to 1 inch	4,920
605	Ontario—Sheet No. 126—Manitoulin Island sheet—Scale 4 miles to 1 inch	3,456
630	Ontario—Sheet No. 129—Missisagi sheet—Scale 4 miles to 1 inch	3,456
708	Ontario—Sheet No. 118—Haliburton sheet—Scale 4 miles to 1 inch	3,456
702	Quebec—Basin of Nottaway river—Scale 10 miles to 1 inch	56,800
593	Nova Scotia—Sheet No. 42—Trafalgar sheet—Scale 1 mile to 1 inch.	216
598	" " 43—Stellarton " — " " "	216
600	" " 44—New Glasgow sheet—Scale 1 mile to 1 in.	216
608	" " 45—Tony River " " " "	216
609	" " 46—Pictou " " " "	216
610	" " 47—Westville " " " "	216
633	" " 48—Eastville " " " "	216
635	" " 56—Shubenacadie " " " "	216
636	" " 57—Truro " " " "	216
637	" " 58—Earltown " " " "	216
709	" Mount Uniacke Gold District—Scale 250 feet to 1 inch.	

Maps completed.

720	Western Ontario—Sheet No. 4—Manitou sheet—Scale 4 miles to 1 inch	3,456
	Ontario—District near Bancroft—Scale 2 miles to 1 inch	
	Ontario and Quebec—Sheet 121—Grenville sheet—Scale 4 miles to 1 in.	4,051
714	" " City of Ottawa and vicinity—Scale 1 mile to 1 inch	450
700	Nova Scotia—Sheet No. 53—Lawrencetown sheet—Scale 1 mile to 1 in.	216
	" Waverly Gold District—Scale 250 feet to 1 inch.....	

Maps in progress.

663	British Columbia—West Kootenay sheet (partly engraved)—Scale 4 miles to 1 inch.....	6,400
	British Columbia—East Kootenay sheet—Scale 4 miles to 1 inch....	6,400
	" " Okanagan sheet—Scale 4 miles to 1 inch.....	6,400
	" " Map of Rocky Mountains—Scales 4 miles to 1 inch	
	" Map of Crows Nest Coal-fields—Scale 2 miles to 1 inch	
	Keewatin and Saskatchewan—Grass River map—Scale 8 miles to 1 [illegible]	
	Ontario—Lake Nipigon map—Scale 4 miles to 1 inch	
	Nipigon River map—Scale 2 miles to 1 inch.....	
	Sheet No. 113—Peterborough sheet—Scale 4 miles to 1 inch	3,456
	" 119—Perth sheet—Scale 4 miles to 1 inch.....	3,456
	" 120—Ottawa sheet—Scale 4 miles to 1 inch.....	3,456
	Ontario and Quebec—Sheet No. 122—Pembroke sheet—Scale 4 miles to 1 inch.....	3,456
	Ungava—Map of East Coast of Hudson Bay—Scale 25 miles to 1 inch	
	New Brunswick—Sheet No. 2, N. W.—Surface Geology—Scale 4 miles 1 inch.....	3,456
	New Brunswick—Sheet No. 17, N. E.—Surface Geology—Scale 4 miles to 1 inch.....	3,456
	Nova Scotia—Sheets Nos. 59 to 65, 76, 82, 100 and 101—Scale 1 mile to 1 inch.....	2,376
	Nova Scotia—Sheets Nos. 54, 55, 66 to 69, 73—Scale 1 mile to 1 inch.	1,512
	" " Catcha Gold District—Scale 250 feet to 1 inch.....	
	" " Montague Gold District—Scale 250 feet to 1 inch.....	
	" " South Uniacke Gold District—Scale 250 feet to 1 inch.	
	" " Tangier Gold District—Scale 250 feet to 1 inch.....	
	4 Index maps—British Columbia; Ontario and Quebec; Quebec and New Brunswick; Nova Scotia.—Scale 50 miles to 1 inch.	

LIBRARY.

Dr. Thorburn, librarian, reports that during the year ended December 31, 1900, there were distributed 17,555 copies of the various publications of the Survey, comprising Annual Reports, special reports and maps; of these 11,755 were distributed in Canada, the remainder, 5,800, in other countries. There were received as exchanges during the year, 2,515 volumes. There were also sold 3,415 of the Survey publications, including reports and maps, for which $543.10 was received.

The number of letters relating to the library sent out, was 1,017, besides 1,545 acknowledgments for publications received by the Survey from exchanges and persons to whom our publications had been sent.

The number of letters relating to the library received, was 1,569; besides 648 acknowledgments for publications sent out.

The number of volumes purchased was 111, and the periodicals subscribed for 34.

The number of volumes bound during the year, was 102. There are now in the library about 13,500 volumes, besides a large number of pamphlets on various scientific subjects.

Visitors to Museum.

The number of visitors to the museum again shows an increase, having been, during the past year, 36,091.

Staff, Appropriations, Expenditure and Correspondence.

The strength of the staff at present employed is fifty-two.

The funds available for the work and the expenditure of the department during the fiscal year ending June 30, 1900, were :—

		Grant.	Expend'ure.
		$ cts.	$ cts.
Civil-list appropriation		53,300 00	
Geological Survey appropriation		60,000 00	
Boring appropriation		5,483 98	
Civil-list salaries			50,650 00
Exploration and survey			27,288 54
Wages of temporary employees			15,115 37
Boring operations			2,174 47
Printing and lithography			15,796 35
Purchase of books and instruments			1,023 51
" chemical apparatus			6 65
" specimens			2,798 53
Stationery, mapping materials and Queen's printer			1,434 99
Incidental and other expenses			3,047 45
Advances to explorers on account of 1900-01			9,537 80
			128,873 66
Deduct, paid in 1898-99 on account of 1899-1900	$16,067 79		
Less, transferred to casual revenue	18 60		
			16,049 19
			112,824 47
Unexpended balance civil-list appropriation			2,650 00
" " boring "			3,309 51
		118,783 98	118,783 98

The correspondence of the department shows a total of 10,290 letters sent, and 8,500 received.

I have the honour to be, sir,

Your obedient servant,

GEORGE M. DAWSON,
Deputy Head and Director

Geological Survey of Canada

GEORGE M. DAWSON, C.M.G., LL.D., F.R.S., DIRECTOR